SPECIAL EDITION NO. 4
February, 1997
Volume 2

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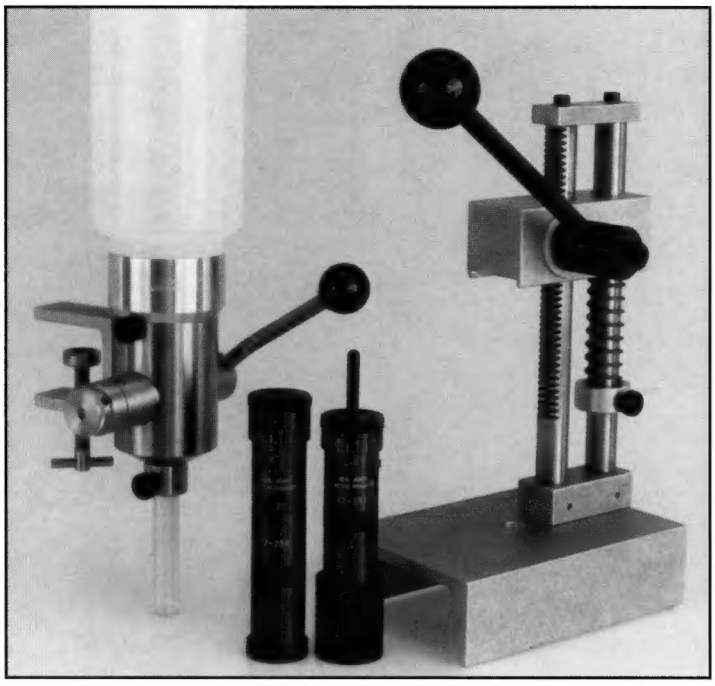

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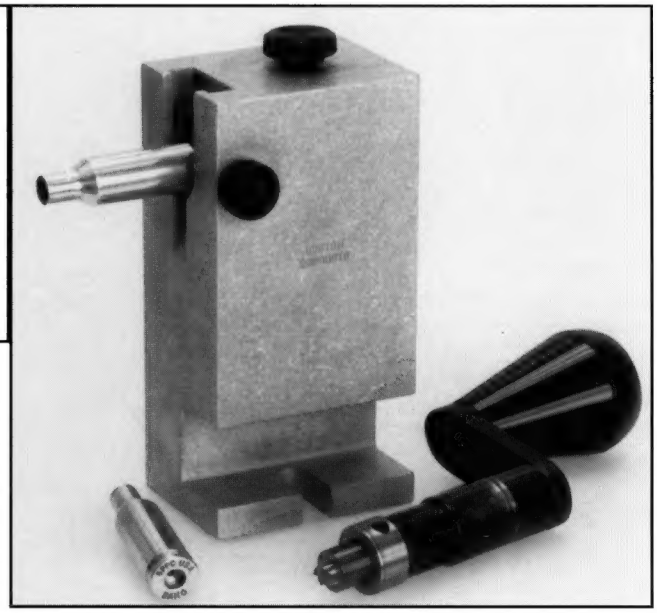

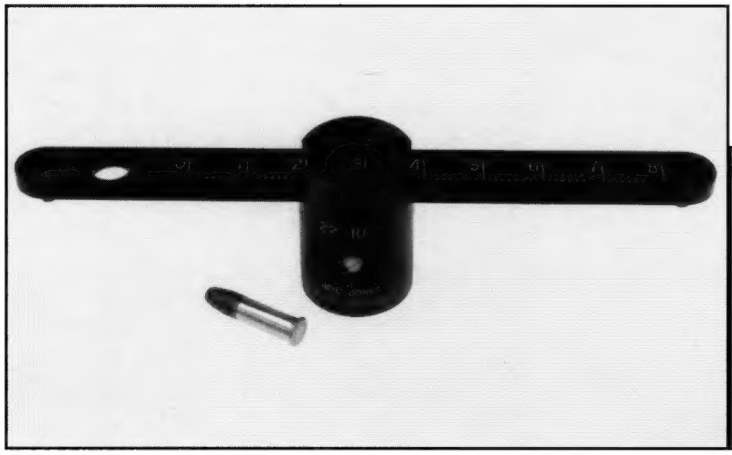

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SOME THOUGHTS ON CHOKING AND BARREL PROFILING

by

Mark White

If we were to look at a typical rifle barrel's pressure curve, we'd see a vertical rise in the chamber to the maximum pressure, followed by a sudden and rapid drop as the projectile was squeezed through the throat and accelerated down the bore. If all rifle barrels were built to correspond solely to the pressures generated they would be quite thick near the breech, drop sharply in diameter about three inches from the action, and have a very gentle taper towards the muzzle, where the wall thickness would be roughly 1/16". I've fired German and Austrian drillings in some fairly powerful chamberings (such as .375 H&H magnum) which had tube walls a touch over 1/16" thick near their muzzles. These rifles were accurate only because their barrels were soldered into a cluster that supplied the required stiffness, and because some Old World artisan knew how to properly apply a bore lap to form a choke, or barely perceptible tightness at the muzzle.

Aside from a barrel's throat, the next most important area is the muzzle. In reality, it is critical that both the throat and the muzzle crown approach perfection. Eighty years ago we had European craftsmen who patiently bored, straightened, rifled, and lapped bores with great skill. It took many, many hours to craft just one barrel. Today a rifle barrel can be bored and reamed in just a few minutes. It can be button rifled in roughly three seconds. With a proper lathe a barrel can then be turned to rough profile in less than fifteen minutes. I recently overheard a major US rifle manufacturer employee mention that the factory cost on a production centerfire rifle barrel was roughly thirteen dollars. While I appreciate the leverage that modern production techniques have afforded us, there is a minor defect in procedure that is delivering barrels which are not as accurate as they could be. There are two ways to fix the problem inherent in manufacture. I will describe the easiest first. Eventually.

The sequencing procedure for producing a barrel from solid bar stock is as follows: 1 - drill, 2 - ream, 3 - straighten (if necessary), 4 - rifle, 5 - turn to profile, 6 - thread, and 7 - chamber. A somewhat better job results if a barrel is rough chambered, screwed into its action, and then finish chambered. This obviously results in less chamber distortion and better headspacing. Don't look for this effort to occur on a production rifle.

If one were to change the production sequence by reaming and broaching (rifling) AFTER turning the exterior profile, the reaming and broaching would produce a bore with a serious and possibly lumpy taper, as the thinner muzzle area would stretch a lot, while the thicker breech section would stretch very little.

The way it is done in the industry is to contour the exterior only after drilling, reaming and broaching. This leaves a bore which is, in theory, fairly uniform and parallel. In practice, it often happens that one end of the barrel blank's bore will be a thousandth or two tighter. This end is usually measured and marked on custom barrel blanks (I know they are on Douglas'), and the prudent gunsmith will thread and chamber the end which is larger. So far, so good. Now we come to the act of turning the barrel to a standard profile. Usually, the breech end of the barrel will be thicker in diameter, while the muzzle end will be thinner. Often, it will be a lot thinner. When metal is removed around a bore, stresses will be relieved, and that area will increase in diameter. A barrel as small as a .22 may have a bore which is up to .0015" larger at the muzzle. I have heard of .458 and .50 caliber bores being as much as .0035" larger at the muzzle. This phenomenon does little for precision shooting, as the

Continued on next page

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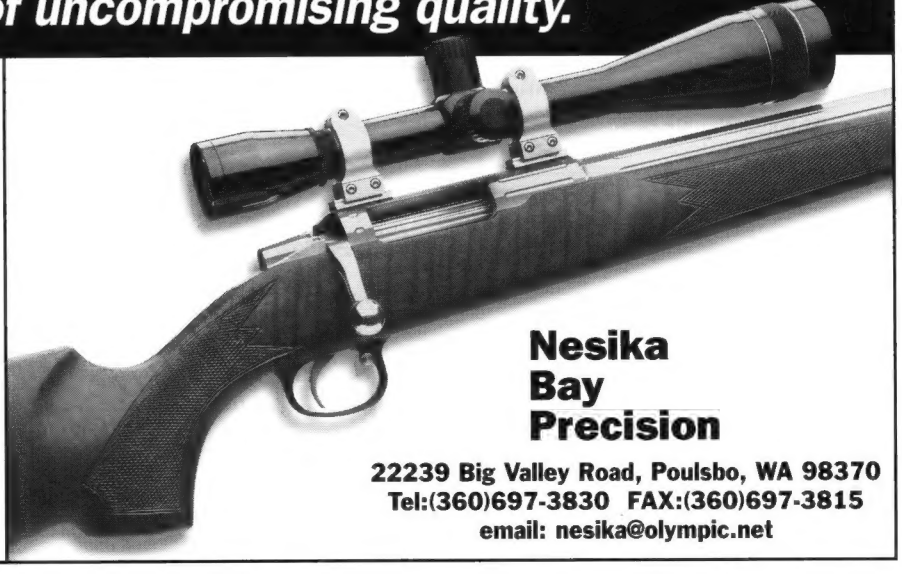

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SOME THOUGHTS ON CHOKING AND BARREL PROFILING

Continued

mild blunderbuss effect makes a bullet indecisive - hesitant about which direction to take.

The easiest production fix would be to leave a large, full diameter glob of metal from two to four inches long at the muzzle. Ideally, this club would be ⅛" to ¼" larger in diameter than the breech area. This would look ugly, but would shoot well. The extra mass would serve to tighten and stabilize the barrel and departing bullets at this point where it is most needed. A secondary option would be to leave a barrel full diameter from breech to muzzle. A number of manufacturers have done this, and it works quite well, although it's a bit heavy. I like the idea of a heavy knob and a slight choke better, as the typical projectile gets a little loose in the bore on its way down. A tightness of, say, half a thousandth will take the slack out. The extra weight will tend to dampen vibrations, making a barrel more tolerant of bullet weight and load variations. I tend to like short barrels, as they are more resistant to vibration. On a .22 LR I like a touch over 16". On a small capacity centerfire cartridge I like around 20" + or -.

In days of old, barrel makers hand lapped the bores of match rifles to provide a slight choke at the muzzle. It is axiomatic that the bore diameter at the muzzle always be less than that at the throat. A few rifles with short chamberings have a thread-caused constriction of one to two thousandths at their breeches, which will cause most soft lead bullets to rattle around on the way out. Jacketed bullets have of course a little more spring to them, and can be a little more forgiving.

It should be mentioned that a barrel with a right hand twist will have a pretty severe left hand reaction to the spin imparted to a bullet. Such a barrel will tend to self-tighten into its RH twist threaded action, hence there should be little need to use a heavy hand in screwing it into place. If it is not tight enough, it soon will be. The reverse is of course true with appendages attached to a barrel's muzzle with RH threads, such as compensators, muzzle weights, flash hiders, silencers, etc. The heavier of these will tend to unscrew of their own apparent accord, as the violent ratchet-like action of a barrel twists to the left with each shot.

The only cure I know of for the reverse choke condition which exists in most rifles with tapered barrels is fire lapping. When abrasive impregnated bullets are fired the abrasive material opens the throat and breech areas first. As each bullet proceeds down the bore the cutting edges which project plug up, break off, and get dull. Obviously smaller particles (finer grit) plug up more rapidly, taking less and cutting less. The net result is that, with skill and knowledge, it is possible to remove choke at the wrong end (breech) with a properly executed fire lapping procedure. One should slug and measure the bore at each end, feel for irregularities, and quit before making the throat too big to accept standard bullets. NECO's abrasives are much more aggressive than others I have used, so one needs to exercise more caution in their use, as they cut much faster. I always finish the fire lapping procedure with at least twenty shots charged with J B Bore paste, as it will provide the finest polish. I believe fire lapping to be superior to hand lapping, as it tends to lay any grain which may exist in a direction towards the muzzle. If a .22 LR bore is properly polished it will tend to stay fairly clean, needing only a patch or two (run from the breech only!) to pull some of the grit out of a short barrel. In a long .22 LR barrel the lube seems to run out at about 18", causing leading near the muzzle. This takes a brush and solvent to remove.

Earlier I mentioned machine induced stresses in barrel metal. There was a time when all barrels were fluted by hand, with files. The flutes were carefully laid out, and the metal was slowly and gently removed. Because fluting has become so popular of late there are those in the industry who use but a single pass with a cutter on each flute, supporting the barrel only at each end. Many otherwise perfectly good barrels have been ruined by fluting, and one must be careful who does the work. It has often been said that the fluting produces a stiffer barrel, but calculations and before/after testing with a dial indicator and a consistent applied load do not bear this out. Fluting is

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attractive, and has always helped sell firearms, but it doesn't necessarily make a rifle any more accurate.

One last thought. Once one has the throat and muzzle just right, hardening the throat and bore will help it to last longer. Some ***PS*** advertisers offer a chemical and a cryo hardening service, which may be worth the expense. That, combined with moly coated bullets and moderate loads could easily double a throat's life. I expect a .22 LR barrel to be good for at least 50,000 rounds. A centerfire with a small case capacity should be good for 8,000 rounds. Hardening may limit the possibility of setting the barrel back 1½ turns and rechambering, as a ruined reamer and the labor may cost more than a new barrel. For reloaders who have enough length in their magazines, it is possible to open the leade up with a throater and seat one's bullet out a little farther. Throaters are cheaper, and can be used without having to remove a barrel from its action.

The thing that eventually wears most throats down is the ground glass used in most priming mixtures. It wouldn't be so bad if it was soft soda lime glass, but it is usually the harder and sharper boro silicate variety. At present, there is no way to negate this abrasive factor. It is introduced in a small amount with each shot, most of it lying in the bottom of the bore. As each new bullet is fired, it traps the ground glass between the ogive/barrel interface, dragging it along. The difference between this action and fire lapping is that fire lapping starts with an abrasively charged bullet which loses its effectiveness as it slides down a bore. The ground boro silicate glass is uniformly distributed longitudinally throughout the bore, but in the side closest to the earth. This eventually results in a mildly eccentric, egg shaped bore with its largest dimension in the 7 o'clock position. In centerfire calibers, heat checking from the double effect of squeezing the bullet and a relatively long exposure to hot, pressurized gas does most of the damage. The intense flash is inevitably followed by a rapid quenching action that leads to checking and cracks which concentrate stress. In retrospect, maybe this is a good thing. It might be boring to shoot through the same old barrel over one's lifetime.

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THE $4.34 GAUGE (PLUS SHIPPING)

by

Mike Winkler

I measure cartridge overall length for 6.5mm and above with a gauge made from a 3 foot section of water hardening drill rod, 1/4 inch diameter ($1.20, order number 06010169, page 903), and two 1/4 inch shaft collars ($1.57 each, order number 88000161, page 1259). Smaller calibers, .224", .243" and .257" require a 3/16 inch diameter rod while .172" needs a 1/8 inch diameter rod. The price, order number and pages are from MSC Industrial Supply Co., at 1 800 645-7270. Shopping by phone is almost a necessity in small communities like mine, that don't have a lot of the hardware items that people in larger cities take for granted.

To use the gauge, hold your rifle securely and horizontally in something like a Shooter's Vise. With the bolt closed and cocked, slide the drill rod carefully down the barrel until it touches the bolt face. Ensure the rod doesn't touch an extended firing pin or ejector. Run one of the shaft collars down the drill rod until it touches the muzzle. Lock it in place. Remove the drill rod and place the other shaft collar on the drill rod end that went down the barrel. Push it down to the collar already locked in position. Once again, carefully slide the drill rod back down the barrel, but not all the way.

Remove or retract the bolt and place the bullet of choice in the chamber. Using a wooden dowel or other suitable item, ease the bullet into the rifling. Gently slide the drill rod down the barrel until it touches the bullet tip. With light tension on both the rod and the dowel, move the bullet slightly away from the rifling and then back into the rifling. You'll feel it touch. Relax the tension on the dowel and drill rod and slide the loose shaft collar down the drill rod to the muzzle. Lock the screw.

Retract the drill rod slightly and using dial calipers, obtain dimension A in Figure 1. Measure the thickness of the first shaft collar tightened, B, and subtract that from A. By the way, shaft collar thickness is very uniform and generally less than .001" difference exists between collars although the listed tolerance is ±.008". The resulting dimension is cartridge overall length for that bullet. To insure you measure precisely where the bullet meets the rifling, go through the process of moving the bullet into the rifling, tightening the second shaft collar and measuring dimension A at least three times. With a bit of practice, you'll get the three measurements to agree within .001".

Save that bullet or record the necessary dimension off a comparator to duplicate it. Do this with the different bullets you intend to use. After 500 to 1000 rounds, check overall length again with one of the original bullets. You may be amazed at the new dimension for overall cartridge length. I know I was when I thought the bullet slid halfway to the muzzle in my .243 Winchester Match rifle after only 1000 rounds. In fact, with considerable throat erosion you may not feel the rifling at all and cartridge overall length will therefore vary with the amount of tension you place on the dowel.

I've measured cartridge overall length in this fashion for 15 years and thought it was pretty simple and straightforward and couldn't be improved. That is, until I saw an article by Glenn R. Latham on page 84 of the Special Edition No. 2 of ***Precision Shooting,*** Volume 1. He had a setup similar to mine, but with an even easier method of obtaining overall length. Slide both collars down to touch the muzzle with the rod end on the bolt face. Lock the outboard collar. Remove the bolt and position the bullet to touch the rifling as above. Lock the inboard collar at the muzzle. Cartridge overall length is now dimension C in Figure 2. Exquisitely simple.

Is there a down side to this simple, accurate operation? Yes, the drill rod ends are not perfectly square and have a slight flare. The latter keeps the collars from sliding on, but a little work with a grinder to square the ends will fix both problems simultaneously. Break the resulting sharp edge with 240 and 400 grit silicon carbide paper and lightly oil the drill rod before sending it down the barrel. On some rifles equipped with a flash suppressor, the shaft collar may fit inside the suppressor. Simply use a fender washer between the collar and suppressor. The procedure remains the same. On bolt action rifles, the locking lug recess becomes a cavern for short bullets. Use your rod guide to push the bullet into the chamber.

Maximum case length is also measured with the $4.34 Gauge by merely substituting a piece of brass turned slightly smaller than neck diameter or a Sinclair Chamber Length Gauge for the bullet and going through the same procedure.

Mike Winkler
401 Birch Ct.
Hanford, CA 93230

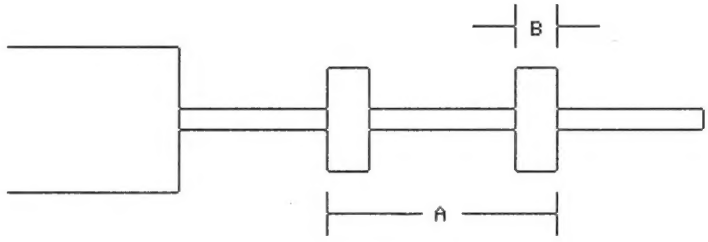

Figure 1

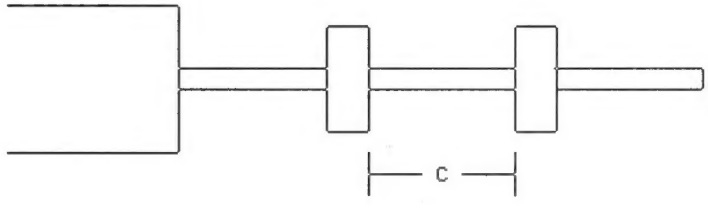

Figure 2

MULTI - RANGE HIGH POWER RELOADS

by

Lester W. Karas

Prologue

The news was devastating for some, for others it was the greatest event which could have happened. It hit all members of the Dominion of Canada Rifle Association, and every Provincial Rifle Association. No more free ammunition with which to carry out practice and competition. The Federal Government, in its policy of restraint, determined that no longer would civilian rifle clubs be subsidized with free ammunition from the Department of Defense. Among others, I joyfully made arrangements to load my own. For now, the large groups and flyers of IVI would become history.

Jack Brogden, a member of the Altcar Rifle Club in England, has long campaigned for the use of handloads in competition. He has referred, quite accurately, to the Service ammunition as "bent arrows which we are forced to use."

In order to carry out their respective shooting programs, various alternatives were arranged. The Ontario Rifle Association allowed competitors to supply their own ammunition, but restricted the bullet to a maximum of 156 grains, at a muzzle velocity not to exceed 2900 feet per second. The program was an outstanding success.

The Dominion of Canada Rifle Association was faced with obtaining a large quantity of target ammunition for sale to competitors for use at the Annual Prize Meeting at Ottawa. The ammunition eventually made available to the competitors was known as "Mexican Match," for it consisted of replacing the military bullet of NATO issue ammunition with the Sierra Palma Matchking bullet. Military ammunition was purchased from offshore suppliers and used as the source for ammunition which was modified and resold to competitors.

1996 was the first year that competitors were permitted to bring or purchase their own ammunition for the Canadian Fullbore Rifle Championships (APM). Ammunition regulations were identical to those established previously by the Ontario Rifle Association.

Service ammunition does not provide maximum accuracy, for it is intended for use under combat conditions. It is intended to have maximum reliability under storage conditions and interchangeability with all weapons of the same calibre. In keeping with the fire and movement tactics of the military, reliability is an absolute requirement rather than target accuracy. To ensure reliability, the neck is crimped on the bullet, the primer is crimped in place, and a lacquer sealant is applied to both the neck and primer.

Continued on next page

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MULTI-RANGE HIGH POWER RELOADS

Continued

Bullet release from the case will vary as a result of both the lacquer and the crimp. These conditions are not conducive to consistent accuracy.

Military ammunition has been made undersize for compatibility in a number of weapons, and also to enable continuous firing in automatic weapons. The barrel and chamber of an automatic weapon will expand due to the heat of firing. This will result in the expansion of steel in all directions, which will actually decrease in size the internal diameter of the barrel and chamber. The use of undersized ammunition therefore allows the weapon to continue firing.

The deliberate use of tight barrels and chambers for match rifles for the DCRA Target Rifle class historically became necessary in order to obtain some degree of accuracy with the use of military ammunition. Like other competitors, my rifle barrels had the tight dimensions required for the military rounds, and I certainly had no intention of discarding a perfectly good match barrel and installation for which I had paid upwards of $500.

The preceding events were those which started me on the way toward hand loading an accurate multi - range load for use in competition.

Introduction

This account is a record of my personal odyssey into the best methods of reloading match ammunition. The intent was to develop hand loads having maximum performance for use in Dominion of Canada Rifle Association competition in Target Rifle class.

The rules were very simple although the solution was not: Find a combination of reloading components which will give optimum results in 7.62 N, with a bullet which does not exceed 156 grains in weight, and which will provide maximum accuracy over the ranges 300 yards to 1000 yards.

Some shooters have used the 5.56 mm at the short ranges, and then switched to the 7.62 N for the longer ranges. The difference in the lower recoil of the 5.56 mm has often been cited as a distinct advantage. Coupled with the lower recoil, however, has been the higher deflection due to wind, which some shooters have accepted. In my own experience, I have never had a problem with the recoil of the 7.62 N, and the accuracy at the longer ranges has always been greater for me with the 7.62 N than with the 5.56 mm.

Creating the most accurate load at 300 yards, and then another for 500 and 600 yards which may require the use of another powder, and then finally another combination for long range, I found was an exercise in futility. As long as Murphy is alive and well, I knew that the possibility was very high that I would find myself at a firing point of a range for which my hand loads were not optimum for that distance.

Another peculiarity was that the first of several rounds usually had a different point of impact when using a different powder from that previously used. For this reason, all my work was directed toward the development of a load using the same powder, at the same loading, which would be accurate at all ranges.

My enthusiasm became somewhat subdued when I realized that I would need 150 rounds for the Provincial Matches, and 450 rounds for the National Matches.

General

I have found in terms of performance, that the bullet and powder form the major contribution to overall accuracy. I was searching for the ultimate combination of components which would give me the degree of accuracy for which I was striving.

In any project, a preliminary search of available literature on the subject is the usual starting point, for there is little point in reinventing the wheel, or of repeating the mistakes of others. And so my project of hand loads which could be used in competition started with a search of what had been done previously. I read all the information I could obtain on the subject with the same degree of interest of the student cramming for final examinations.

I read what Dave Milosevich, in *The Precision Shooting Reloading Guide* (Reference 2) had written in his article, "Reloading for Highpower." I found it an excellent starting point. The method of preparing brass for bench rest competition was outlined by Russ Haydon in *Reloading For Accuracy* (Reference 1).

I decided early in this project to go the route of moly - coated bullets, again for the documented advantages which this coating held. And finally, I was able to use the bench rest method of firing in order to determine the accuracy of my reloads.

Principles of Score

I knew that in high power competition, the final score on the target is determined by a combination of personal skill in holding, aiming and judging of the wind. To this must be added the use of high quality equipment. Each factor will enlarge groups, in a quantitative sense. It is possible, however, to determine the contribution to group size for the rifle and ammunition separate from aiming and holding the rifle in position.

Once the contribution to overall group size of the individual factors is known, then appropriate corrective action for each item can be taken to decrease the size of that individual contribution.

Under normal conditions, the wind and the shooter form the largest contribution to error. In all circumstances, it is desirable to have the errors due to the rifle and ammunition as small as possible. It is obvious that when a large error due to ammunition is combined with large shooter holding and aiming errors, and an error in reading the wind is included, then the total error on the target becomes excessively large. When each quantity can be made individually as small as possible, then the sum, representative of total error, will become small as well.

Mathematically, the total error is equal to the square root of the sum of the squares of each individual error. By using consistent units, say overall group size in minutes of angle, some useful numbers become evident.

A suitable high power telescope sight, say 24X will reduce the aiming error to 1/24 MOA. Firing from the bench under conditions of no wind will thus provide a value of minutes of angle attributable to rifle and ammunition.

My intention was to reduce, as far as possible, the contribution of error due to the rifle and ammunition in hand loads which would replace Service ammunition. In previous tests, I found that the error due to DAQ ammunition in my rifle was in the order of 1 to 1 1/4 minutes of angle. That due to IVI was consistently worse, with values which varied from 1 1/4 to 1 3/4 minutes of angle. In my handloads, I was looking for values of less than half of that given by Service ammunition.

Results of Investigation

My fundamental research into the work by Russ Haydon in Reference 1 indicated that the accuracy of any firearm, assuming a good quality barrel, is determined by, and also limited by the quality of ammunition fired within the rifle.

Further research into the manufacture of cartridge cases was quite revealing, in that the cases are manufactured by a series of drawing and punching operations. The primer pockets and flash holes are formed by swaging, punching, or

both. Similarly, the sides of cases may vary in thickness as a result of this procedure. Since all operations are done from the outside of the case, imperfections and burrs may be left internally which are not immediately visible. Any imperfections, in barrel or ammunition, will affect the ultimate accuracy.

The effect of imperfections in ammunition is cumulative, since each flaw adds to the influence of all others. Normal manufacturing tolerances cause brass cartridge cases to vary in wall thickness around the circumference of their bodies, since cases are punch drawn as previously stated, and for that reason, may not be concentric.

Information from NECO, (Reference 3), also gave some further enlightening information. When a case is fired which has a thin wall section, stretch will more readily occur at this thin side, transferring more pressure to the bolt face at that point. This introduces an unbalanced force which causes bolt whip and vibration of the rifle in its bedding. This force will vary from one shot to another as the cases are inserted into the rifle chamber with their thin sides oriented in a random fashion. The problem is intensified under conditions of brass which is too hard or springy to fire form to the chamber, in which case the stretching of the case's thin side will cause it to develop a curve along the length of its body. The immediate effect is a case head which is not square to the bolt face, and excessive runout, or misalignment of the neck and bullet will occur.

Up to the present time there has been a lack of suitable instrumentation with which to measure case wall thickness. Without such measurement for straightness and case wall thickness, these procedures have been neglected because of these difficulties of measurement.

The accuracy problems caused by nonuniform case wall thickness can be minimized, or perhaps even eliminated, by indexing the cases, as described in Reference 3, and then firing with the thin sides always oriented in the same direction in the chamber. This results in a minimum bolt whip and vibration within the rifle during firing. Thus while misalignment is still present, it is always in a consistent manner and direction. The resultant group, verified by field accuracy testing, has been found smaller than one which is fired with random location of cases in the chamber.

In order to measure case thickness, I purchased a gauge from Nostalgia Enterprises Company. The case gauge marketed by this company is capable, not only of case wall thickness, but also of concentricity and bullet runout measurements.

Reloading Manuals

My research also provided me with a rude awakening, for the specified combinations for reloads approaching maximum as given in all reloading manuals were not practical for the tight barrels which I owned.

Manufacturers of firearms and ammunition adhere to standards set by the Sporting Arms and Ammunition Manufacturers Institute. These dimensions and tolerances for each calibre are provided to ensure maximum safety, and to allow a maximum round to fit into a minimum chamber and barrel. Maximum safe operating pressures were therefore determined for each loading, but only under SAAMI conditions, which could not be used for my Target Rifle class barrels.

Pressures

As expected, when a bullet measuring 0.3082 inches is fired in a DCRA match barrel which typically has a groove diameter of 0.3065 inches, much higher pressures will be obtained due to the swaging down and engraving of the bullet in the barrel. Pressures will be higher than those shown in all reloading manuals.

The use of moly - plated bullets also results in velocities different from those shown in the reloading manuals due to reduced friction and reduced pressure within the bore of the rifle. All of these factors had to be taken into account for the development of the match loads.

To be worthy of use in competition, ammunition must deliver good and predictable results from a large number of rounds in a given rifle under a wide variety of temperature conditions on the range.

My research indicated that good accuracy from any reload required that the powder charge must burn at the same rate and pressure for each shot. According to a number of powder suppliers, powder will burn reliably within a specific pressure range of 45,000 to 60,000 pounds per square inch. If the powder charge is too small, or the powder is too slow in burning rate, pressure will not be optimum for a consistent and clean powder burn. The result is powder fouling and erratic velocity. Similarly, a high pressure due to a fast powder or too much powder may also result in erratic velocity and accuracy. A load developed during cold weather may prove to be too high in pressure during the hot weather period of most competitions.

I found that moly - coated bullets with their lower coefficient of friction, had a tendency toward lower pressures, while tighter dimensions of the barrel would contribute toward higher pressures. With the number of unknowns I was dealing with in my reloads, I felt it necessary to purchase additional instrumentation.

In order to assist in working with unknown velocities, I purchased a chronograph at the beginning of the development of my loads. I started with mild loads, and monitored velocities while watching very carefully for signs of over pressure on the cases, such as cratered primers, stiff extraction or case dimension increases.

Case Preparation

All literature available for reloading under bench rest competition stated that the brass case must, of necessity when reloaded, be equivalent to tolerances within which the rifle was first built and chambered. In this manner, the concentric rings of chamber, lugs, and barrel threads, which have been established for rifle assembly had to be integrated and duplicated within the cartridge for accuracy.

In keeping with the basic principles, in order to provide maximum performance

Continued on next page

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of the ammunition, it is necessary to use known good components of brass, primers, powders and bullets properly assembled in its manufacture. Thus one must start with known good brass cases. This is normally derived from new unprimed cases, obtainable from commercial sources, since these are intended for reloading purposes. By contrast, military brass cases can be obtained free, or at very low cost, however military brass is of a harder alloy, intended to be fired only once, under service conditions, from weapons which may be worn or dirty. The removal of the crimp is a time - consuming process, and the rejection rate of such cases may be high. Thus while the price may be right, it is poor economy to use military brass. Even once-fired commercial brass is not recommended if it has been fired in different rifles, picked up at a public range, or is composed of different lot numbers.

As my starting point, I purchased 500 new commercial unprimed Winchester cases in .308 W, all of the same lot number. Each case required a number of operations to be carried out upon it for consistency. While these operations were tedious, they were deemed to be absolutely essential to final accuracy, and are detailed in the following procedures.

Preliminary Operations on the Brass

The first operation consisted of primer pocket reaming or uniforming to ensure consistent depth and size. This presented the opportunity to inspect individual brass cases for the presence of a flash hole, off centering of that flash hole, and any other manufacturing defects which were evident. I discarded such cases for firing purposes, but was able to use them later for setup of the loading dies.

Sinclair International has a line of primer pocket uniformers in their 8000 series. This series allows the uniformer to be inserted into a power screwdriver or in a handle for manual operation.

The sizing button of the full length resizing die as made by most manufacturers will usually result in drag on the case upon withdrawal. Since the case is not supported during this operation, it is highly likely that distortion of the case will occur during this portion of full length resizing operations. In order to prevent this situation, I removed the case neck button from the die, chucked the stem and button into the jaws of a portable drill and polished the button with very fine emery cloth. It was necessary only to remove imperfections and roughness without reducing the diameter.

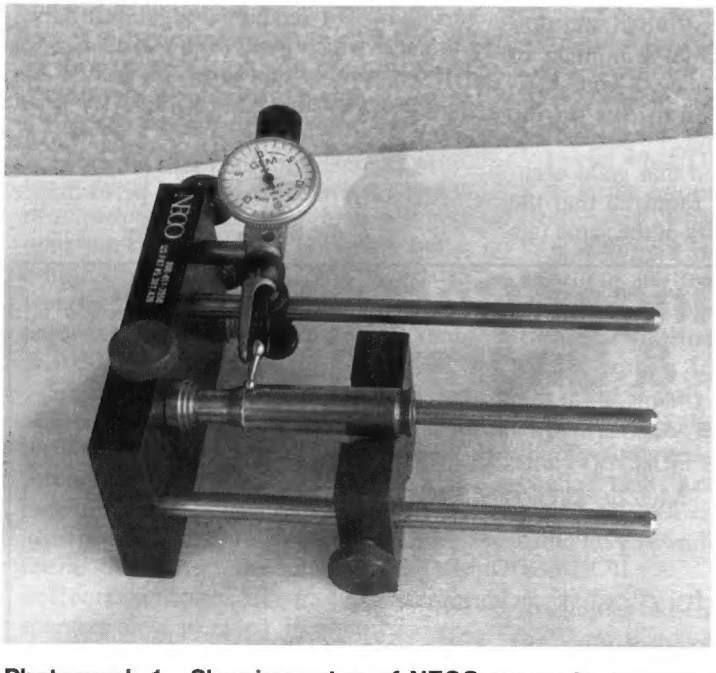
The next operation was the setup of the full length resizing die, which determines the headspace of the loaded cartridge. Standard headspace is measured, in rimless cases, as the distance from the base of the cartridge case to a datum point on the shoulder. In practical terms, it is measured with a separate gauge, which consists of a body to receive the case, with a headspace nut which is threaded to the case body. As the nut is turned on to the body, a set of micrometer graduations on the nut itself will reference to the tapered shoulder of the case and provide a measured length of headspace. The RCBS Precision Micrometer No. 88329 for the 7.62 N round was used with complete satisfaction.

The separate headspace gauge was first used to measure the headspace of brass cases which had been fired previously in the rifle. I found this value for my Wichita - Kreiger rifle, in 7.62 N, was 1.6280 inches. Then with the neck resizing button removed from the die, I lubricated a brass case which I had formerly discarded in the selection process, and ran it through the full length resizing die. I set the head space of the cartridge by adjusting the distance of the case holder from the full length resizing die, a trial and error method, using discarded brass, until the headspace of the trial case was equal to the fired case or 0.001 " shorter. This ensured easier chambering without excess working of the brass.

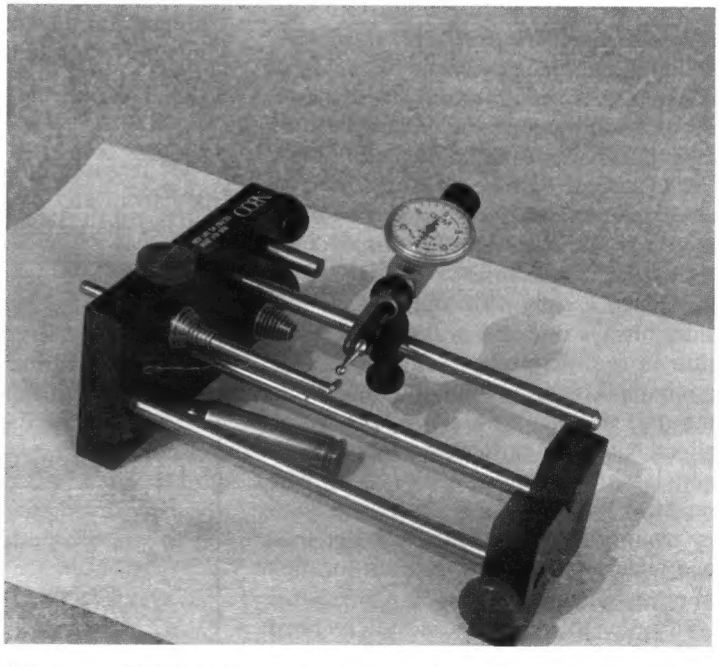
Full Length Resizing and Preparation

At this point, I reinstalled the polished neck resizing button in the die. I lubricated all brass prior to the full length resizing operation, including the case neck. The interior of the neck was lubricated with powdered molybdenum disulphide by means of a special brush and container.

After full length resizing all cases, I measured each case for total indicated runout at a point just past the shoulder. Cases which showed more than 0.001 " out of round were set aside for practice, and not used in competition. This function



Photograph 1. Showing setup of NECO gauge to measure TIR at case shoulder



Photograph 2A. Showing probe setup for case wall thickness

was done using the NECO instrumentation set up as shown in Photograph 1.

I turned all case necks to ensure consistent brass thickness at the neck. No more brass than necessary to ensure this consistent thickness was removed. This was a once-only operation, done initially on the brass.

After the necks were turned, the cases were trimmed to an overall length of 2.015 inches, and any burrs at the neck removed. I used a hand - held tool made by L. E. Wilson to remove both external and internal burrs at the neck.

The next operation carried out was that of removing burrs from the flash hole of the case. A special deburring tool made by RCBS, was set initially by the trimmed length of the case. Internal burrs of the flash hole were removed without removing excess brass from inside the case. This operation needed to be done only once.

At this point, I had a quantity of prepared brass, but the most important measurement had not yet been taken. This was the measurement of the case wall thickness, as described previously.

Case Wall Thickness

By setup of the NECO gauge, as shown in Photographs 2A and 2B, wall thickness of the brass cases was measured at the case near the head, but below the extraction groove. I set aside for practice any cases which varied more than 0.003 inches in thickness. The brass case thin side was marked by filing a notch on the rim, to allow consistent orientation of the loaded round when inserted in the chamber of the rifle.

I weighed all cases and separated them in batches by weight of plus or minus 0.5 grain only after all of the preceding operations had been carried out. While individual weighing of all cases was an extremely tedious operation, it was the only way in which cases with internal flaws were finally eliminated.

Bullets and Loaded Rounds

Earlier this year, I had decided to go with the coated bullets in competition, and the advantages which they would confer. NECO has developed a technique by which bullets may be impact plated with molybdenum disulphide, or moly for short. I obtained from NECO a plating kit, which had sufficient material to coat several thousand bullets.

The plating procedure was done in accordance with the supplied instructions in two steps:

1. Impact plating of the bullets by tumbling them in a case tumbler using a mixture of finely divided moly and hardened steel shot.

2. Then tumbling the bullets in a mixture of hardened powdered carnauba wax and hardened steel shot until the impact plating was complete.

According to published technical information, firing these moly-coated bullets in the rifle resulted in less fouling of the barrel, with resultant easier cleaning of the barrel. A consistent and verifiable increase in accuracy by a reduction of group size was stated by a number of authorities. Metallic fouling from the bullet was stated to be no longer present, and this absence seems to have provided more consistent accuracy.

While sufficiently accurate ammunition may be fabricated without benefit of the preceding, it would seem that the principles outlined could only enhance accuracy. There have been no measured or known detriments yet determined by this process.

I purchased 800 Sierra Matchking bullets in 155 grain Palma .30 calibre configuration, and proceeded to coat the bullets with moly in accordance with the directions given in the NECO kit.

After a number of trials, the result was a whole lot of shiny, black bullets. By their looks alone, they appeared capable of great things, and I could not wait to seat them into my prepared cases.

In order to seat the bullets with minimum runout, I used the Redding Benchrest Competition Bullet Seating Die No. RD55155. This die has full support of the case during the bullet insertion, and is also fully adjustable for seating depth. Loaded rounds were checked on the NECO gauge for total indicated runout, set up as shown in Photograph 3. I set an arbitrary limit of 0.001 " for maximum accuracy. Rounds having a TIR greater than 0.001 " were relegated to practice only.

Loading for Maximum Accuracy

A number of variables were found to enter into the equation for accurate reloads due to the wide variety of components available. These were as follows:

1. Primers. Bench rest primers have normally given more consistent groups than the regular and magnum versions.

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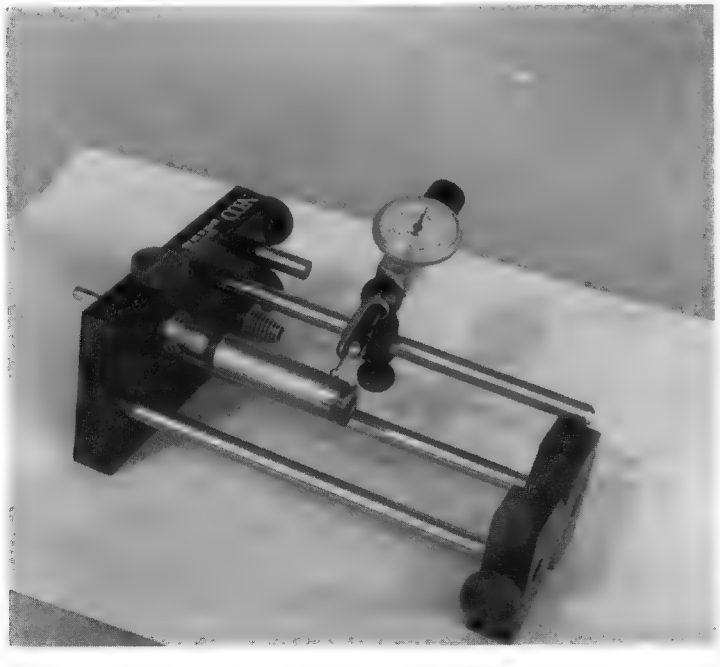
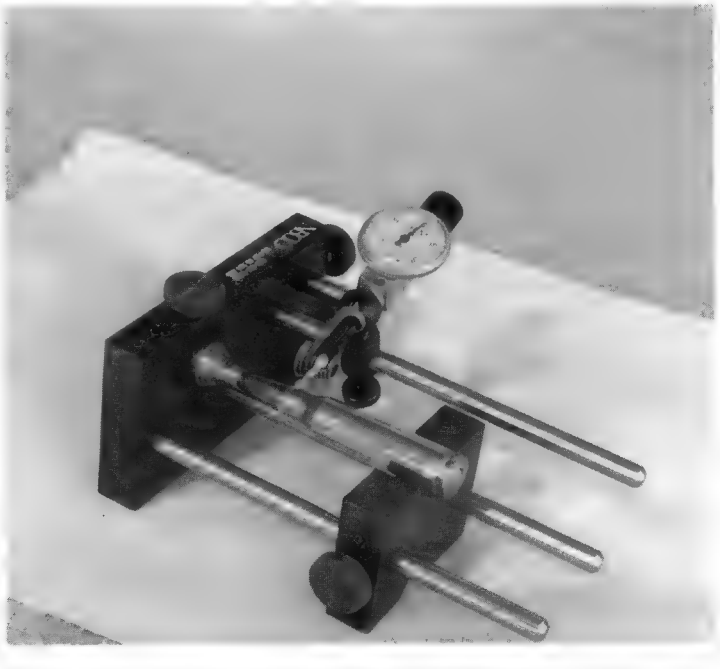


Photograph 2B. Showing case being measured for wall thickness



Photograph 3. Showing setup of NECO gauge to measure TIR of loaded round

MULTI-RANGE HIGH POWER RELOADS

Continued

TABLE 1

POWDER	WEIGHT	AV. VEL.	EXT. SP.	ST. DEV.	O.L.	GP. INS
3031	41.6	2858	50	14.5	2.770	0.650
4064	44.0	2931	45	12.6	2.770	0.632
N140	44.5	2871	56	20.4	2.770	0.410
N140	44.5	2891	29	11.3	2.770	0.375

TABLE 2.

POWDER	WEIGHT	AV. VEL.	EXT. SP.	ST. DEV.	O.L.	GP.INS.
3031	41.8	2893	62	21.5	2.770	0.610
3031	42.0	2890	45	16.5	2.770	0.670
3031	42.0	2922	23	8.2	2.770	0.535
N140	45.0	2892	40	17.6	2.770	0.470
N140	45.0	2874	51	16.4	2.770	0.380

TABLE 3.

POWDER	WEIGHT	AV. VEL.	EXT. SP.	ST. DEV.	O. L.	GP.INS.
N140	45.0	2880	25	12	2.765	0.467
N140	45.0	2890	20	10	2.760	0.370
N140	45.5	2930	16	7	2.760	0.257

NOTE

AV. VEL. = AVERAGE VELOCITY
ST. DEV. = STANDARD DEVIATION
GP. INS. = GROUP SIZE, INCHES
EXT. SP. = EXTREME SPREAD
O. L. = OVERALL LENGTH, INCHES

NOTE

All preceding loads were safe in the writer's rifle. No representation of safety of these loads for other rifles or circumstances is made or implied.

For this reason, I used only Federal 210M primers in the development of hand loads.

2. Powder. Either ball or extruded powder may be used, with advantages to each type. Better metering through a powder measure is a feature of the ball type. Extruded powder is found to be more difficult to dispense. The results were those obtained as shown in Tables 1, 2, and 3.

3. Bullets. The type, weight, and seating depth in the case of all bullets were of particular importance to resultant accuracy. All loads were developed with the known accurate Sierra Palma Matchking bullets, with a weight of 155 grains, which were treated with moly.

With all the variations possible within the loaded ammunition, steps were taken toward eliminating or defining each variable of the loading process.

I seated the primers with a hand priming tool from Sinclair. While the primer seater from the reloading press may be used, the immense leverage available from the press does not permit seating primers by "feel" when the primer has bottomed in its pocket in the case, which is a function of Sinclair's hand tool.

My research also indicated an absolute requirement that long range ammunition should have the lowest extreme spread in velocity. A low standard deviation usually comes with a low velocity spread. And this without exception, means that the powder must be weighed very carefully to better than one tenth of a grain. Charges which have been metered only simply do not have the required low velocity spread at long range.

In order to accomplish this task, I set the powder measure to throw approximately 0.5 grain less than required. The powder was then dumped onto the pan of a powder scale, and the powder charge weight was then brought up carefully to the required value by means of a powder dribbler, adding to that which was already in the pan, until the required weight was obtained.

My reloading for accuracy was started with a bullet type which had proven to be accurate in the past. A number of rounds, with different powders were loaded, with safe, or low loads, with all bullets touching the lands. This dimension was obtained by means of the Sinclair bullet seating depth tool.

All bullets were seated first to touch the lands, giving an overall length of 2.770 inches for my Wichita-Kreiger rifle.

The total indicated runout of the bullet was measured with the tool set up as in Photograph 3, and any which exceeded .001 inch were set aside for practice.

Shooting Technique

From the 100 yard bench rest, using the telescope sight, I shot a number of rounds with each separate powder. The following procedure was then carried out:

1. From the observed groups, I made a selection for minimum group size with a particular powder.

2. When fired over the chronograph, velocity and standard deviations were measured.

3. Firing for group size was done separately, with the identical bench rest and from the same batch of reloads as that used for chronographing. This was done in order to eliminate accidental shooting and consequent destruction of the chronograph.

4. When a type of powder had been determined from targets showing a minimum group, the bullet seating depth was then reduced by increments of 0.005 inches from the lands, and a number of rounds were so loaded, but using the identical powder weight.

5. Groups and velocity measurements were again fired from the bench rest with the bullets at different seating depths, and from the results a seating depth giving maximum accuracy was selected.

6. Once minimum group size was obtained at the target with a particular seating depth, the powder weight was then increased. The procedure after that became one of loading up a number of rounds for groups while varying the powder weight.

The stated intent was to have an accurate loading which would result in the bullet having a muzzle velocity high enough to enable the bullet in its flight to remain above the speed of sound at the maximum range at which it will be fired.

Under this arrangement, should groups begin to open up as powder weight is increased, it would have been necessary to take the next minimum size group from another powder, and start over, although some of the parameters previously determined could be used.

According to ballistic data for the Sierra Palma bullet, when the minimum muzzle velocity was 2900 feet per second or greater, the remaining velocity of the round would be considerably above the velocity of sound at 1100 feet per second at 1000 yards.

In load development, final chronograph readings were used to determine most consistent muzzle velocities with minimum standard deviation. This value, for best results with target ammunition, should be less than 10, with minimum group size, and at the stated muzzle velocity equal to or greater than 2900 feet per second.

There followed at this point a number of groups fired from the bench rest with a series of experimental loads. Some, but not all, are shown in Tables 1, 2 and 3, however only those leading to a concrete solution have been included.

While striving for decent loads from the bench rest using IMR powders, I found that the extreme spread of velocities could vary by 40 to 90 feet per second, and standard deviations from 20 to 40. Obviously something was not according to Hoyle. Then I received a letter from Jack Brogden in England, and he mentioned developing a load using Vihtavuori powder. Included in the letter were test results which he had obtained, using the identical, but untreated Sierra bullets.

Jack had put together a set of loads using 45.8 grains of Vihtavuori N140 powder with the Sierra bullet. His results were eye - openers for me. Average velocity was 2899, with extreme spread of 16 ft./sec., and standard deviation was 7. This set was not unique, for other test results which he sent ranged even better, with standard deviations as low as 4. While I had been striving to obtain similar values, he had already accomplished the task. I now knew that I had to obtain some Vihtavuori powder in order to obtain similar results.

Vihtavuori powder is manufactured in Finland, and is generally not available in

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MULTI-RANGE HIGH POWER RELOADS

Continued

Canada. Various gunshops told me that this powder was not available, or that it had not been permitted by the Energy and Resources Branch of the Federal government, or some similar excuse. I finally located two pounds of this powder in Kitchener, about 90 miles away. I did not know how he had obtained it, nor did I care, but I wanted that powder very badly. I immediately reserved it and drove down to pick it up.

I realized from the start that the most consistent loads from the bench may not always be the most accurate across the range. For this reason, the load developed was intended for further evaluation in practice at the ranges involved. At the same time, an inconsistent load which would not shoot from the bench was not likely to shoot at the required ranges either, and it was discarded.

Results

I loaded up some loads using the N140 powder, the results of which are given in Tables 1, 2, and 3. In each case, group sizes were smaller with the Vihtavuori powder, and in most cases, standard deviations were also smaller.

Table 1 shows the results of reloads with three most likely powders, IMR 3031 and 4064 and with Vihtavuori N140. Reasonable results were obtained with the bullets seated to just touch the lands, which in my rifle under consideration was 2.770". IMR 4895 and WW748 powders were also loaded, but due to large groups were discarded for further consideration.

Table 2 shows a further set of results, with the bullets touching the lands, with loads of IMR 3031 and Vihtavuori N140 powder. These results show a decreasing group size, and a reducing standard deviation. There was a temptation to stop right there, but further refinement was possible.

Table 3 shows the improved results with change in seating depth. Best results were obtained with 45.5 grains of N140 powder, with the bullets seated 0.010" from the lands, for an overall length of 2.760". This load was later evaluated in practice, and it was found to provide consistent elevation results.

The elevation results are shown in Tables 4 and 5, and were taken from actual competition during the Annual Matches. The elevation at both ranges has been consistently better than 1 1/4 MOA. It is evident that personal errors of wind judging have entered the equation, and need to be corrected.

Notes on Developing the Most Accurate Load

From the work carried out, some observations may be made. For if there is a trap, it is the temptation to do a combination of changes in load development while searching for the optimum.

Only one variable at a time must be changed. In this way, the load development is broken down into stages. In determining the best powder charge, only the powder charge can be varied. When the best bullet or the best seating depth was sought, only that one variable should be changed at a time. Notes must be maintained on all reloading done.

Some observations may be in order at this point. The truly accurate rifle and load is one which is **consistently** accurate. Repeatability also involves accuracy over a period of time, over a number of ranges, and under different weather conditions.

Most shooters who reload tend to concentrate on bullet and powder selection in their efforts at accurate load development. This is useful, but I have found it to be only part of developing a load which matches the vibrations of the rifle. In actual fact, there may be several powders that will give nearly identical accuracy in the rifle under consideration.

Primers have a very great effect on velocity variations. The primer must be matched to the powder weight in order to obtain the lowest possible extreme spread in velocity. While scientific results may not be available, from results on the range, I have found that the mildest primer that will adequately ignite the powder will result in the smallest extreme spread in velocity.

According to several authorities, the most important part of a proper reload is that of having the bullets started down the barrel in proper alignment, with as little distortion as possible. For this reason, each cartridge case and loaded round must be measured. The total indicated runout of the case must first be measured, and must not exceed 0.001"prior to loading. The bullet, when seated, must have a total indicated runout not in excess of 0.001".

Conclusion

When an accurate load has been developed at the bench rest, that load must be checked at the ranges at which it will be fired, and under the identical circumstances of range and weather temperatures as far as possible. It is conceivable that a load developed under bench rest conditions may not be ideal under actual conditions at the required extended range. But a load which will not perform adequately on the bench, at short range, with the benefit of a good telescope sight and shot from stable sand bags or bench rest, will usually not perform properly at extended ranges with metallic sights while the rifle is held by the shooter.

Entirely functional ammunition has been loaded in the past without the benefit of the preceding details. In the severe competition under the present circumstances, however, every detail of accurate loading must be incorporated in rounds intended for serious competition. In addition to first class equipment must also be added highest standards of personal performance.

Personal Evaluation

I have found that competitive rifle shooting is the most challenging game on earth, for then it is the shooter alone on the firing point against all the forces of the world. Nothing you can do will affect the scores of others. By the same token, nothing anyone else can do will affect your score. It is far more satisfying to me to have competed, and to have my name appear on the list of winners than it is to have my name appear on an article which I have written.

The load described, when used in my Wichita - Kreiger Target Rifle, did indeed put my name on the list of winners at the 115th Annual Matches of the Ontario Rifle Association. This load has given every indication that it would have been a winner at the National Matches in Ottawa as well. Due to my wife's ill health, I did not attend the National Matches, for she could not accompany me, and I would not leave her for the required 10 days.

There are, believe it or not, some aspects of life which are more important than shooting.

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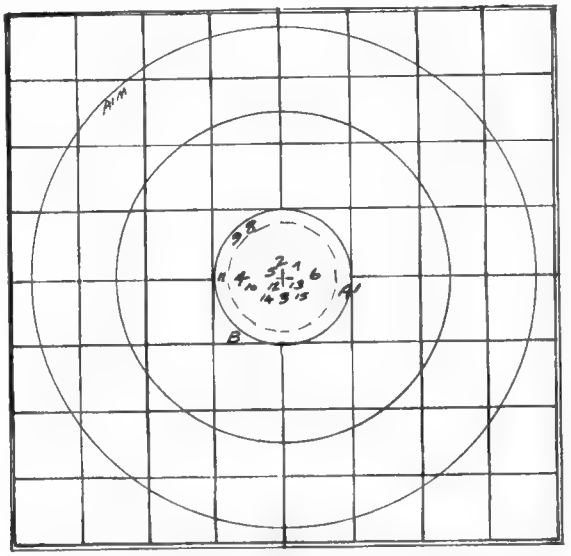
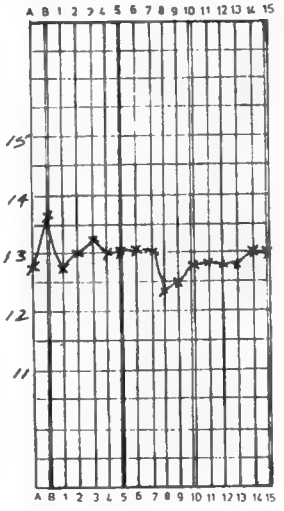
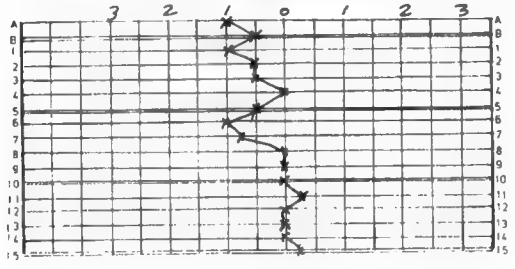


RANGE 500 YD.



NO.	ELEV.	WIND LEFT	WIND RIGHT	CALL	VAL.
A	12.5	—	—		
B	"	1.0			
1	12.75	—	—		
2	"	.5			
3	"	"			
4	13.0	"			
5	"	"			
6	"	"			
7	"	"			
8	"	"			
9	"	"			
10	13.25	"			
11	"	"			
12	"	—	—		
13	"	—	—		
14	"	.25			
15	"	"			



SIGHT CORR. FACTOR 1.0 TOTAL 74.11

PLACE BORDEN DATE 9AUG96 TIME _____

EVENT BANKERS RANGE MONS

RELAY C BUTT _____ TARGET 12

RIFLE WICHITA 914 - KREIGER

SIGHT C-H, G530 I.S. 3.7 mm.

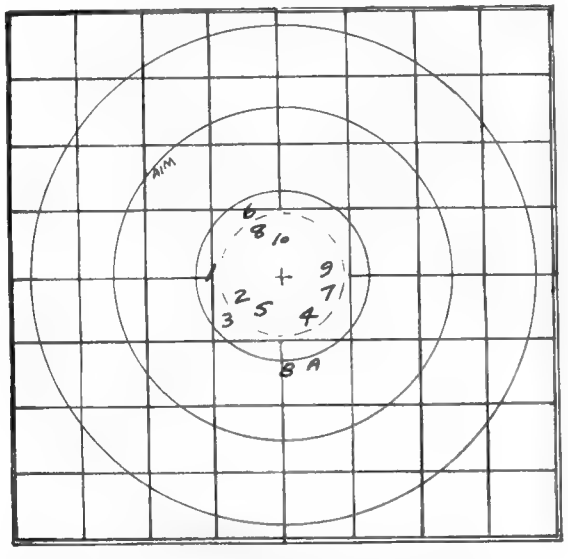
AMMO, 45.5/N140, 155 gr. SIERRA

WEATHER SUNNY, +80°F

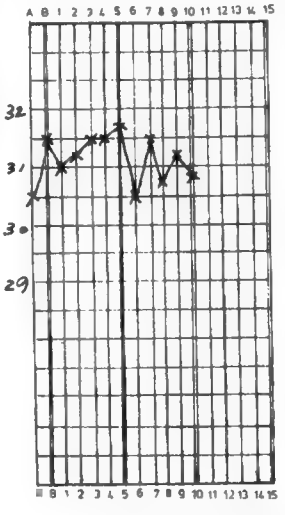
LUK 95

TABLE 4. 500 YARD ELEVATION

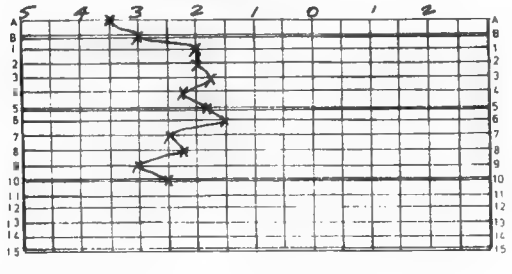
DCRA



RANGE 900 YD.



NO.	ELEV.	WIND LEFT	WIND RIGHT	CALL	VAL.
A	29.0	3.0			
B	30.0	"			
1	31.0	"			
2	"	2.5			V
3	"	"			S
4	"	2.0			V
5	31.25	"			V
6	31.5	"			S
7	31.25	"			V
8	"	2.5			V
9	"	"			V
10	"	"			V
11					
12					
13					
14					
15					



SIGHT CORR. FACTOR 1.0 TOTAL 50.7

PLACE BORDEN DATE 9AUG96 TIME _____

EVENT PRESIDENTS RANGE MONS

RELAY C BUTT _____ TARGET 10

RIFLE WICHITA 914 - KREIGER

SIGHT C-H, G530 I.S. 2.9 mm.

AMMO, 45.5/N140, SIERRA PALMA 155 gr.

WEATHER SUNNY, +80°F.

LUK 95

TABLE 5. 900 YARD ELEVATION

BUILDING A LOW COST BENCH REST ARBOR PRESS

by

Harry Weitz

(Photo by Don Ballasch)

One of the basic tools used in reloading bench rest ammunition is an arbor press. The arbor press is used for a variety of operations in the making of this ammunition, including neck-forming and neck-sizing, shoulder set back, bullet seating, etc. Each of these steps requires a tool that is accurate (i.e., true vertical movement of the plunger), has the ability to deliver the requisite force, is rugged,easily adaptable to different die lengths, lightweight, and low cost. The homemade arbor press presented in this article meets all of these criteria, with a few extra virtues thrown in.

The building of this press is simplicity itself. There are three pieces that comprise the entire tool (in addition to screws, washers, and lock washers):

- The base (Item 1, below);
- The vertical member (Item 2), and
- The toggle (Item 3).

The toggle is not shown in the drawings, but can be seen in the photographs.

The material for the base (Item 1) and for the vertical member (Item 2) is aluminum plate. The aluminum plate was purchased as a two foot length of ½"x 4" stock and hacksawed to the size shown in the drawings. After cutting items 1 and 2 to size, file all raw edges smooth. Bevel one edge of the base as shown in detail "C" of the drawings if you intend to weld the structure. (Welding produces a stiffer structure compared to the use of bolts.) Otherwise, use the three alignment screws as permanent holding screws (detail "C"). At this point, assemble the base to the vertical member. Carefully check the squareness of the two parts. It is absolutely necessary that these two members be square. Make necessary alterations to surface "A" to ensure this squareness. Use a caliper to ensure that dimensions "B" are within .010". If the two members are to be welded, check squareness before the welder puts his torch to the work. The three aligning screws can remain after welding. After welding, file or sand the bottom of the base flat. Check for squareness.

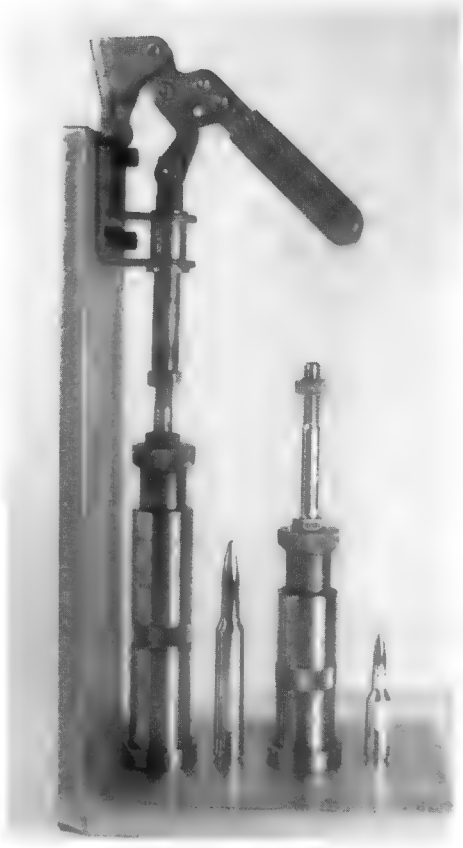
The toggle is a purchased part. The DE-STA-CO Model (see Bill of Materials at the end of this article) has an internally threaded plunger. This feature allows for added flexibility in the use of the press by providing for the use of different length spindles (bolts) for different heights of dies and other press uses. I use two bolts for all my needs, one 5/16"-18x1" long and another 5/16"-18x5" long. They are both hex head.

After joining base and vertical member, locate the four holes for the toggle mechanism. (If you are using a different brand than the one indicated in the Bill of Materials, it probably will be necessary to change hole locations and hole size.) File all sharp edges and form the four corner radii as shown. Check the squareness of base to vertical, as well as the squareness of plunger to base. If necessary, loosen four toggle screws to achieve squareness.

You are now finished with the assembly. I have used an arbor press similar to the one describes in this article since 1952. I hope you have as much success with it as I have.

Good shooting!

Harry Weitz
(619) 451-1189



Bench Rest Arbor Press - Bill of Materials

Item No.	Description	Where Purchased	Cost
1 below)	Base, aluminum 1/2" x 4" x 5 1/2"	Local scrap shop	$2.50 (includes vertical member
2	Vertical member, aluminum 1/2" x 4 x 10 1/2"	Local scrap shop	
3 (Not Shown)	DE-STA-CO Push/Pull Toggle Clamp* (Catalog #94, Part #GH-302-F, pg. G-831, Series MA55)	L&N Industrial Tool & Supply Co. 7895 Convoy Court, #9 San Diego, CA 92111 (619) 279-8880 (619) 279-2319 (fax) Or purchase from your local industrial tool supply company	$8.20
4 (Not shown)	Welding service, heliarc welding	Local auto repair shop	$7.50
		TOTAL COST	$18.20

* The plunger (ram) of the toggle clamp has a 1 1/4" travel. The plunger is internally threaded to accept 5/16"-18" spindles (bolts).

USE SOCKET HD. CAP SCREWS
8-32 × 1" LG. (DETAIL C)
8-32 × 3/4" LG (TO MOUNT TOGGLE)

BENCHREST ARBOR PRESS

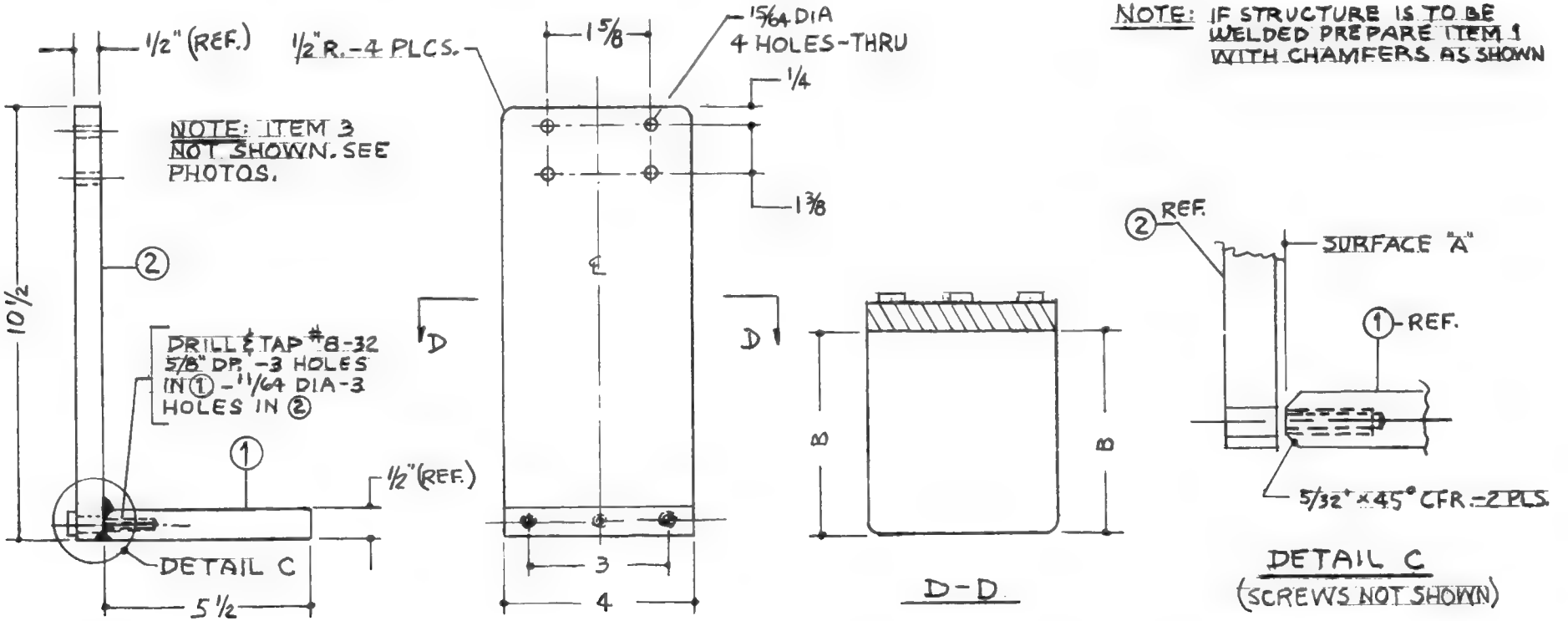
DETAILS AND ASS'Y.

DESIGNED BY H. WEITZ

6-11-95

NO SCALE

NOTE: IF STRUCTURE IS TO BE WELDED PREPARE ITEM 1 WITH CHAMFERS AS SHOWN



PRODUCT REVIEW: "Diamond Tool Holder"

Reviewed by
John M. Eckenrode

Recently I had a chance to work with a unique type of lathe tool holder described by its manufacturer as a "Tangential" tool holder. Designed and manufactured by D&P Burke Toolmakers of Melbourne, Australia, it is marketed here in the U.S. by BAY-COM. I have to admit that initially I had a few reservations about the toolholder , as it was advertised as being able to do "5 Basic turning functions, ALL in one tool: Roughing cuts, Finishing cuts, Shoulder facing, End facing, and Thread cutting." I had visions of the advertisements on the "boob tube" from ten or so years ago of the "Ginsu" knife, that sliced, diced, peeled, pared, and even cut soda cans.

While I never owned a "Ginsu", this product performs in accordance with its advertising claims, and does so very well. Photo #1 shows the diamond tool holder "kit" as received, tool holder in the top of the photo, grinding fixture (jig), and a ¼" tool bit. A hex key to use with both the holder and grinding jig is also included – a nice touch. The instructions included with the kit are well illustrated and easy to follow. As the instruction sheet indicates, this tool derives its name from the "tangential" position in which it is held in relation to the work piece. From the (lathe) operators position, the square tool blank is held so that one corner on the blank faces the operator, and its opposite faces the work piece to form the cutting edge. The only portion of the tool that is sharpened is the top face. The various rake angles for the cutting edge of the tool are built into the toolholder itself.

To sharpen for most turning operations, a ¼" square tool blank is merely placed in the grinding jig, and the Allen screw/washer tightened to hold the blank in position. The jig is then placed on the grinding table/tool rest, and the face of the bit presented against the grinding wheel. Photo #2 shows the tool blank and jig prepared for grinding a tool for straight turning. This set up is virtually "idiot proof", a real plus for many folks (of which I am) who are not very adept at freehand grinding of lathe tools. A slight radius should be stoned onto the forward corner of the tool, and then you are ready to place the tool in the toolholder and go to work!

I put this tool "through the paces" while performing my typical shop chores: making up tooling, rebarreling a few rifles, making parts, etc. What impressed me initially about the Diamond tool holder was its ability to make a **heavy** cut. I deliberately tried to see how much this tool would take before the finish of the work piece, or edge of the tool would give up. Much to my surprise, I found that this tool readily performs tasks that I normally would reserve for carbide tooling. Working with scrap "mystery metal" I threw chips that were on the brink of igniting the cutting oil in the chip pan, and it kept cutting, and cutting, and cutting. When the tip finally failed (workpiece surface finish turned rough and ugly), I fully expected a ragged, jagged edge having deformed and broken down from heat build up. Instead I found a tiny "dimple" on the tip of the tool, and a slight indication of heat build up. This made me curious, so I took the grinding jig, and set it up in my tool & cutter grinder so that I could measure the amount of material required to restore the cutting edge. Much to my amazement, the point was restored after only .004 down feed on my grinding wheel, and the tool looked and cut like new again. You can make those little pieces of High Speed Steel go a loooong way at .004 per resharpening – I figure I won't need to buy any more ¼" tool banks until around 2025! I should stress here that the tool and cutter grinder was only used here to measure the amount necessary to clean off the worn face of the tool bit, and is by no means necessary for either initial sharpening or resharpening of the tools. All these activities can be accomplished on a regular bench grinder.

As advertised, threading can also be accomplished with this tool, and the instructions are, in a word, simple. In fact, **So** simple that I was sure that I was missing something in the explanation and diagram presented in the instructions, and

Photo 1

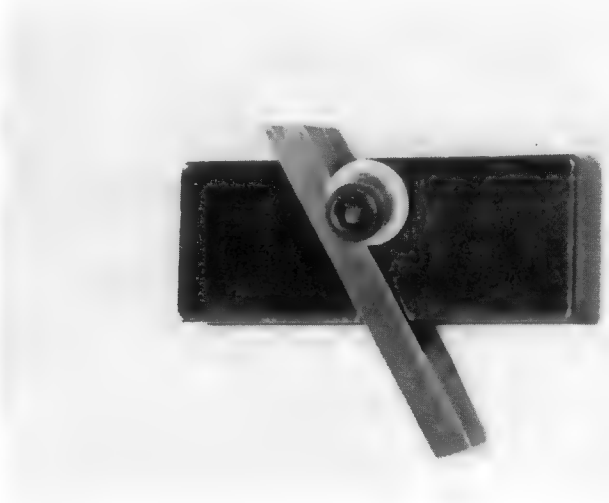


Photo 2

referred to BAY-COM's "Diamond Tool Holder" video ($10). This brief (approx. 10-15 min.) video provides a short introduction to the tool, shows its use in a variety of turning operations, as well as sharpening tool blanks for both straight turning and threading. This too is an Australian production, the video's narrator providing that Aussie accent that is sure to be a hit if your spouse was a "Crocodile Dundee" fan.

To sharpen for threading, the face of a tool blank is sharpened as described above. Then the blank is placed in the groove running along the face of the jig, with the "tallest" edge, or point facing up, as shown in Photo #3. Placed on the grinding table/tool rest, the forward edge is then "plunge" ground for approx. ¼", and the angle checked with a thread gauge. The angle of the grind (usually 60 degrees) can then be adjusted with the Allen head screw which extends through the grinding jig. Once the proper angle is set, finish grinding until the point is sharp, "touch up" the top face again, and you are ready to get to work at the lathe. The whole process almost takes less time to perform than it took for me to explain. The tool bit is then placed in the tool holder and set up as you would any other threading tool.

In use, the Diamond Tool holder performed a variety of operations well. Photo #4 shows the tool taking a light cut on a piece of scrap steel, and producing a fine finish. Photo #5 shows the tool taking a much heavier cut of approx. .200. All cuts were performed dry. While speed and feed needs to be kept within the realm of HSS tooling, this tool design exhibits much better durability than carbide. While making some odd tooling in the shop, interrupted cuts posed no problem, normally a weak point for carbide (not to mention cost). In testing this tool, I used both the tool blank included in the kit (appeared to be standard HSS) and a 5% Cobalt alloy. In actual use, the alloy didn't seem to make much difference. I'll mention here that one should grind a threading tool to be used for that operation only, and a separate tool for straight turning, although I suppose it is possible to grind a "Turning end" and a "Threading end" on one tool blank.

The only operation that I couldn't perform with this tool related to gunsmithing was barrel crowning. With that one exception, the Diamond Toolholder is very versatile, robust, and easy to sharpen (easily its biggest plus). It is manufactured in a variety of shank sizes, for lathes from 6" up to 14" swing, all utilizing ¼" square tool blanks. While this tool initially seemed expensive, in my use, the time saved at the grinder more than offset the price. The "Diamond Tool Holder" ($99.50 - 104.50 depending on size) and its companion video are available from: BAY-COM, P.O. Box 1603, Acme, MI 49610 (616) 276-7194. Tell them you read about it in ***Precision Shooting***.

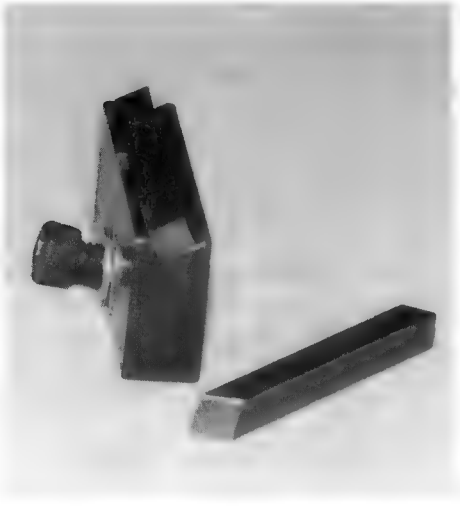


Photo 3

ANTHONY'S PRECISION RIFLES

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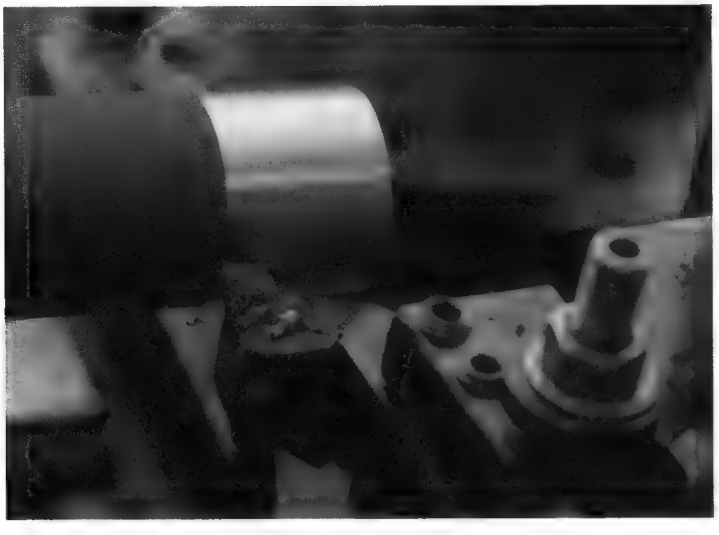


Photo 4

Photo 5

.300 WINCHESTER MAGNUM HEADSPACE

by

Mike Stiverson

Sometimes seemingly small incidents can lead to revelations that upset ideas held for a long time. For instance, one day late last fall Ron Yerian called and asked if he could come over and measure a few 7mm Remington magnum cases with my RCBS Precision Mic. As I was between 7mm magnums at the time, I told him to bring his own cases. It turned out that he already had a Precision Mic in 7mm Remington, and wanted to confirm the "puzzling" headspace readings that he had been getting. I watched as he compared the reading from the two Precision Mics. No problem. The readings matched. Both Mics indicated an average headspace of .014 inches UNDER the minimum indicated by the Precision Mic.

Sizing die problem? No, the cartridges were factory loaded. He left, mumbling under his breath about going back to .22 Hornets and .225 Winchesters. He will probably be telling you about the 7mm Remington Magnum and headspace, and you will probably do what I did, which is start measuring other belted magnum cartridges. The results will startle you.

I had been helping a friend of mine reload for his .300 Winchester magnum but, even though I had a Precision Mic in that caliber, had not measured any of the cases, as he had set his sizing die to touch the shellholder "like the book says". Still intrigued by the 7mm Remington measurements, I found a box of factory new .300 Winchester and started measuring. I suggest you sit down while you do this. The factory loaded rounds - Winchester Fail Safe 180 grain .300 Winchester - measured from .022 to .026 under the minimum as established by the Precision Mic.

Those of you who load standard rimless cartridges - .308, .30-06, 7mm Mauser, etc. - would not even think of firing a cartridge with such headspace. Assuming that it would fire, a case separation would almost certainly result. In the .300 Winchester, nothing seems to go wrong. I then measured some empty cases that had been fired in my friend's rifle - a Parker Hale Mauser - and found that they measured a uniform .006 over minimum, certainly acceptable in a hunting rifle.

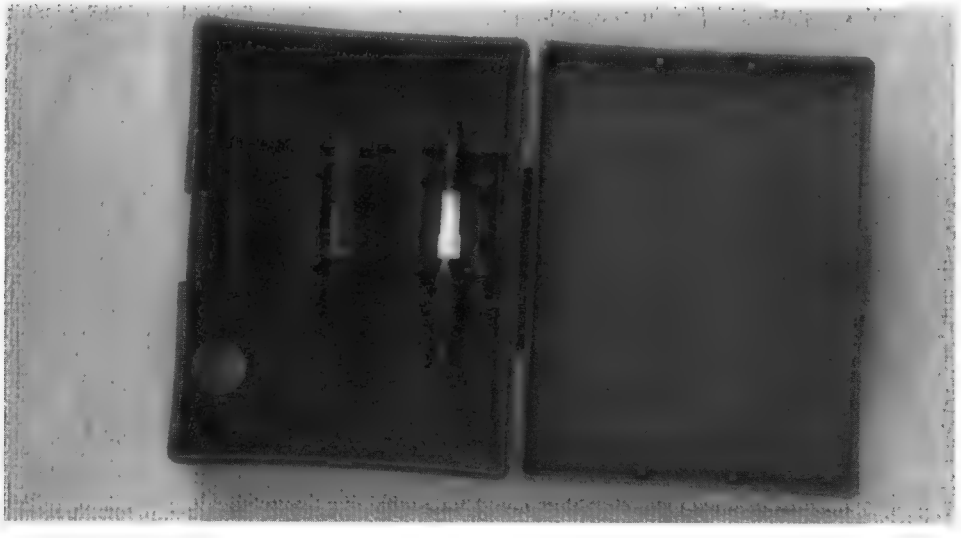
Still not quite believing the apparent discrepancy between chamber and cartridge, I obtained loaded cartridges from the various major manufacturers and recorded the headspace as measured by the Precision Mic. I am presenting these measurements merely for information. I have the bar codes and stock numbers if anyone is interested.

My reloading die, a LYMANS Standard, will size cases to .015 under minimum when set to touch the shellholder. In other words, there is a whole lot of stretching going on from the initial firing through repeated reloadings, stretching that would spell disaster in a rimless cartridge. Other than causing a lot of case trimming, I haven't heard of many other problems with belted magnum cases.

I did find that it is more difficult to properly set up a sizing die for magnum cartridges. Apparently, the strength of the brass and the difficulty of squeezing the brass back to close to the original dimensions in the area of the case head affect the inherent "give" in the press itself. In any event, expect to spend some time adjusting the lock ring on your sizing die. I also found that a uniform job of lubing the cases helps to give uniform sizing results. I still found some variation among sized cases - as much as .003 inch, as measured by the Precision Mic. You simply do not get this much variation in rimless cases such as the .308

Continued on next page

Factory Cartridge	Headspace
Winchester Fail Safe, 180 grain - FS	.022 - .026 under minimum
Winchester 150 grain Power Point	.018 - .025 under minimum
Hornady Custom 180 grain Interlock	.024 - .026 under minimum
Federal Premium Safari 180 gr. Nosler P	.011 - .014 under minimum
Remington 150 grain Core-Lokt	.011 - .013 under minimum



Precision Mic in .300 Winchester.

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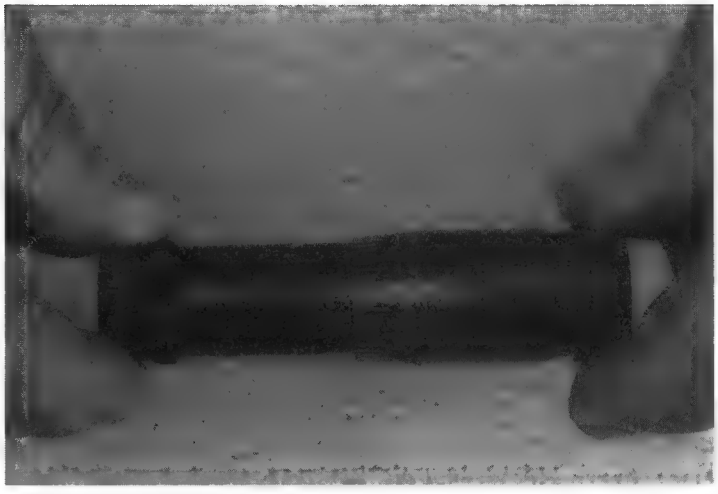
Reading throat depth with Precision Mic.



Fired case being measured for headspace (indicates plus headspace).

Winchester.

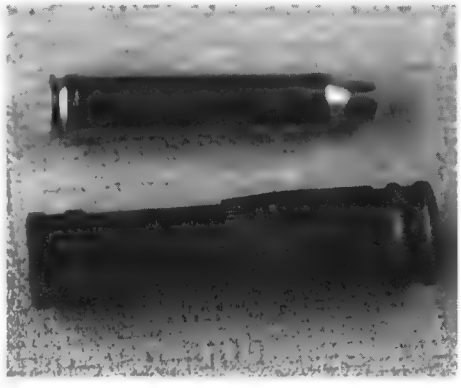
In an effort to go to the experts, I called all of the manufacturers. To a man (or woman, as the case may be), all insisted that they manufactured their cases, and their loaded cartridges, to SAMMI specifications. I called RCBS, and they insisted that their Precision Mics were based on SAMMI specifications, as were their sizing dies. In fact, the manufacturers who also make rifles insist that their chambers are cut to SAMMI specifications.

I also located another .300 Winchester Magnum, a post-64 Model 70 Winchester, and proceeded to measure some cases fired in it. The fired cases indicated a plus .009 headspace. Yet, the person who owns the rifle shoots factory Winchester rounds, with their negative .025 inch or so headspace, exclusively, and gets accuracy in the one and one-half inch range at one hundred yards. I defy you to shoot a rimless cartridge with .030 inch negative headspace and not have problems, and poor accuracy will be the least of them!

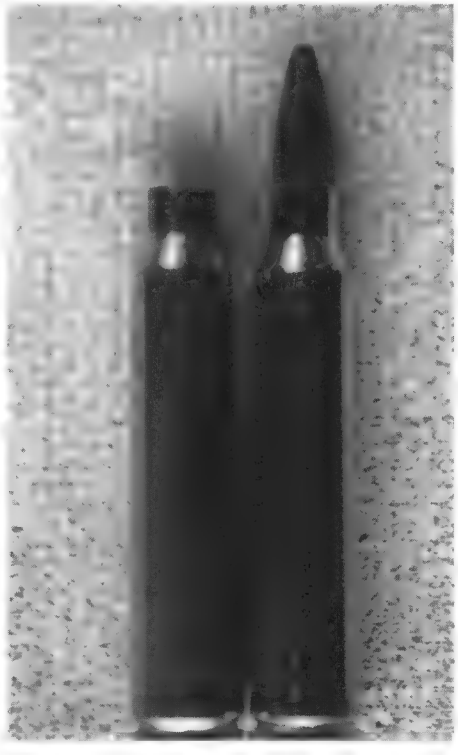
I assume that most of you have a vague idea at least of how the RCBS Precision Mic works as far as measuring headspace goes. It is, very simply, a calibrated device for measuring, in .001 inch increments, the length of a cartridge case from the case head to a point on the shoulder, thus indicating the "headspace" length compared to a factory established zero measurement. It is amazingly simple to use. The Precision Mic also contains accessories for measuring freebore in your rifle to aid in finding the correct bullet seating depth. In the Model 70 Winchester that we were playing with, the bullets were well off the lands when the cartridges were loaded to maximum length for the magazine. There are other devices on the market that will measure freebore, but no other device makes the measurement of headspace so "user friendly". I will not willingly load without a Precision Mic if RCBS makes one in that particular caliber, but their selection is limited to pretty much standard calibers. (No, they will not make custom Precision Mics for you. I have asked.)

I don't know what's going on here, but I'm sure that someone out there knows something about headspace and belted magnum cases. The contributors to this magazine include gunsmiths who cut magnum chambers. Perhaps they can shed some light on proper case and chamber dimensions. The contributors also include long range shooters, both benchrest and Camp Perry style, who regularly load and shoot magnum cartridges with outstanding success. I'm certain that these fine folks can come to our aid.

In the meantime, I think I'll put off buying any rifles chambered for belted magnum cartridges. I have a nice reworked 1914 Enfield action that was slated for some magnum cartridge, but now I'm having second thoughts (maybe a .458 American, a straight-sided case).



Fired case from Model 70 indicates plus .009 headspace.



Visible difference in head-to-shoulder length between fired case and factory round.

SEVEN DAYS OF SMALLBORE PRONE

Dedicated to the memory of Shankha Kalin and Werner Kalin

by

Randolph Constantine

Every year, along about the end of February, this former southerner (I was born and raised in North Carolina) gets tired of being cold and having to wear long johns all the time. I want to go somewhere that's warm. So, each year in early March, Miss Penelope (that's what I, in southern fashion, occasionally call my wife) and I load up our trailer and head down to Phoenix for a couple of weeks of respite from the cold and the snow of Colorado and to visit former neighbors who have moved south.

It just so happens that there is a pair of Smallbore Prone matches held on successive week-ends down there at the same time called the Roadrunner 3200 and the Western Wildcat 6400. I get to shoot in these while the non-shooting Miss Penelope gets to go shopping, visit old friends, or sit in the warm sun and read mysteries. Wives are so understanding.

In my article, "Improving Your Prone Skills" [***PS*** Annual #3, pp. 319-340], I recommended that Highpower shooters should take up Smallbore Prone. This was a prescription I took and continue to take, and which, for me at least, has proved very efficacious. In this article I have a recommendation for Smallbore Prone shooters that they may find, shall we say, interesting.

THE TRIP TO PHOENIX

At the outset, I had a great temptation to subtitle this, "Some Heaven, Some Hell." Most of the Hell came early in the trip. We packed up the trailer on a Wednesday in preparation for getting on the road early on Thursday. The plan was to get to Phoenix early enough on Thursday to get set up and have all day Friday to get in some much needed practice.

It seems that every year the weather fools me into thinking that with just one more day of sunshine, my backyard range will be usable, and I shall be able to get some practice in. Then it snows. However, this being ready to leave early in the day was a great change for your author since I am, ah, temporally challenged. I would have been a charter member of the Procrastinators Society if I had gotten my membership application in on time.

We got up Thursday morning, loaded up some last minute items and tried to hook up the trailer. We were going to be able to leave by 10:00 and maybe get to Phoenix in daylight! What, me get someplace early? Never fear, we had been visited by Murphy. The electric jack on the trailer would not work. The trailer battery was so dead it sucked in every available electron leaving none for jack. We spent about an hour sitting around, waiting around, charging the battery. Once the battery was charged (partially), we hooked up and did the usual pre-drive tests: lights, turn signals, brake lights, etc. We had no brake lights at all, and while the left rear turn signal on the trailer worked OK, the right one did not. Strange.

We left anyway and pulled the trailer, lightless on 160, to our local RV dealer. When we got there it was 12:30 and all the service personnel were out to lunch. More waiting around. When the service guys came back from lunch, one found a couple of blown fuses, the replacement of which partially fixed one problem, but did nothing for another problem which seemed to be intermittent. The suggestion was that we take the car to a dealer and have the steering column torn into and the turn signal switch replaced. Yeah, right. We decided we could live with the intermittent problem, paid our bill and headed out, this time for real. Phoenix here we come.

We got as far as Farmington, New Mexico when all sorts of smoke began pouring out from under the car. Under load, the automatic transmission started leaking fluid onto the exhaust pipe. Disgusted and with a frustration level mounting higher and higher, we turned around and headed for home. We dropped the trailer off at an RV dealer we know in Aztec, New Mexico and drove home stopping from time to time to top up the fluid level in the transmission. Two quarts of ATF later, we got home. This was not supposed to happen; we had had the transmission serviced the week before in anticipation of the trip. It began to look as if I not only was not going to get any practice this year, I might not even get to shoot in the matches. I began thinking up some new lyrics to "By the Time I get to Phoenix" that are not printable in a nice magazine like this.

The next morning (Friday) we left the ailing vehicle at home and set out with another. We picked up the trailer and headed south. We had no trouble on the big hill west of Farmington where the other car had begun spraying ATF. Everything seemed fine, but Murphy was not through with us.

Somewhere on US 666 (appropriately numbered) between Shiprock and Gallup, New Mexico, the needle of the voltage meter started slipping back toward zero. Everything died just after we crossed into Arizona, and we spent another hour (or so it seemed) waiting in a sleet storm for a wrecker. All that had happened was that the alternator had died, but the effect was ultimately a shut down of everything. The dead alternator was quickly replaced; and after another delay of only an hour and a half, we were on our way again. I guess Murphy gave up and went off to bother someone else, for we had no more problems.

Even with all the delays, we arrived at the Phoenix Rod and Gun Club range at South Mountain considerably earlier than we had the previous year, when we had gotten there sometime around midnight and were greeted by George Stidworthy who was walking his two golden retrievers in the beautiful warmth. This year it was only about 7:30 p.m., but a day late and quite a few dollars shorter.

We got the trailer parked and fell into bed. In the morning, we awoke to the sounds of gunfire, as the Phoenix R&GC range is next door to the Phoenix Police Academy. This did not seem too abnormal to us, accustomed as we were to camping on rifle ranges.

THE GAME OF OUTDOOR SMALLBORE PRONE

If you are not familiar with the game of Smallbore Prone, let me give you a capsule description of what happens and when. Obviously, all shooting is done outdoors in the Prone position with a rifle chambered for the 22 longrifle cartridge. There is a standard match format.

In Smallbore Prone, the matches are usually shot in increments of 160 shots

on any one day. These 160 shots are divided up among four 40-shot matches, three of which seem relatively sensible, and one which is peculiar to the SB Prone game. The three are 40 shots at each of 50 yards, 50 meters and 100 yards. The slightly odd one is called the Dewar match and consists of 20 shots at 50 yards and 20 shots at 100 yards. Since I am relatively new to this SB game, I do not know the history of this or how and why such a match format came about.

Each of the 40-shot matches is shot in two, 20-shot stages, primarily because the targets cannot reasonably accommodate more shots. There are four record bulls on the 50-yard and 50-meter targets and only two record bulls on the 100-yard target (The standard targets are shown in Photo 1.). At 50 yards and at 50 meters, the shooter is allowed to shoot only 5 shots on each of the bulls; at 100 yards, he/she gets to shoot 10 shots on each bull. This is done for two reasons: First of all, I don't know anybody who would want to lie there for 40 minutes at one time and shoot 40 shots for record and perhaps as many sighters; twenty minutes for 20 shots is long enough. Secondly, given that most of the folks in the Master class are going to be shooting little bitty clusters in the X-ring, it would be almost impossible to score the targets with twice as many as the number of shots currently allowed on each bull, even if the backers were moved a lot further to the rear of the target. It is hard enough as it is. In actuality, the priorities are probably reversed; I doubt that anybody ever considered how the shooters might feel.

The match format goes like this. The shooters get called to the line at 0900. None of this O-dark thirty stuff for smallbore shooters. The shooters will have already carried their target frames out to the 50 yard line and installed them in the pipes that are permanently set in the ground. On the frames they hang a 50 yard target and a backer. They have already set up their equipment on their firing point which is where it will stay all day. In the smallbore world, you don't have to move your equipment from one firing point or firing line to another during the day; you move the target frames out to different distances instead.

After being called to the line and being given a 3-minute preparation period, the shooters are given 20 minutes in which they may fire as many sighters as they want to, at any time they want to at the sighter bull, and incidentally 20 shots for record. The sighter bull is the top bull on the target. In the photo, you can see that each target has a line across it below the sighter bull. All bullet holes above this line are ignored as far as scoring is concerned; and with one technical exception, all bullet holes below this line are considered to be record shots.

Since each match consists of 40 shots and the targets only accommodate 20 shots, there is a break after the 20 minutes for the shooters to go out to pick up the fired targets and hang a new target. You are not allowed to touch your target or backer; you pick up the target to the right of the one you shot on. This break is not a formal break of a specified amount of time. It's a "don't waste time, go out, hang a new target, get back and get back into position" break.

The order in which the matches are shot is usually: Dewar, 100-yard, 50 meter, 50-yard. After the 50 yard stage of the Dewar match, the shooters carry the target frames out to the 100-yard line and hang 100 yard targets for the last 20 shots of that match. After the Dewar, the frames are left at the 100-yard line for the 100-yard match, after which they are moved in to the 50 meter line, and so on.

Once the second stage of the Dewar is finished, the shooters take a 20- or 30-minute break — very civilized, time for a nice cup of tea don't you know. This pattern continues throughout the day: 40-shot match, 20/30-minute break, 40-shot match, 20/30-minute break, and then last match of the day. There is no specific break for lunch; most shooters usually eat a little something during each break rather than having a big meal.

THE ROADRUNNER 3200

I got my squadding ticket, hauled my gear to the firing line and got ready to shoot this match without having shot any Outdoor Prone since the previous October when I had shot in the New Mexico Smallbore Prone State Championship in Albuquerque where the match was called in the middle of the second day because of a sandstorm. I was beginning to feel a little like Joe Bpfstlk, the character in Li'l Abner who always had a black cloud over him.

The Phoenix Roadrunner 3200 match is shot on a Saturday and Sunday and is one of the few matches that I (in my vast ignorance) know of that allows any sights on both days. Usually, in a 3200 point

Continued on next page

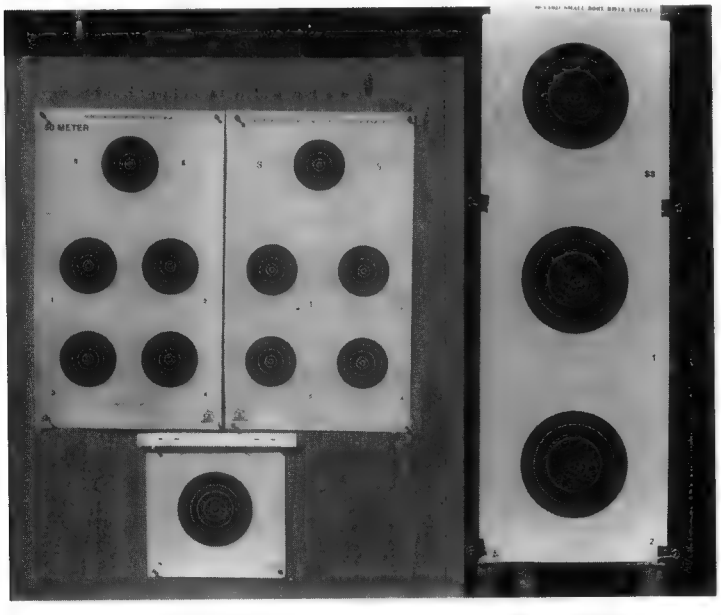


PHOTO #1 The standard targets for Smallbore Prone. The bottom target is the Highpower Prone Slowfire target that is used at 100 yards.

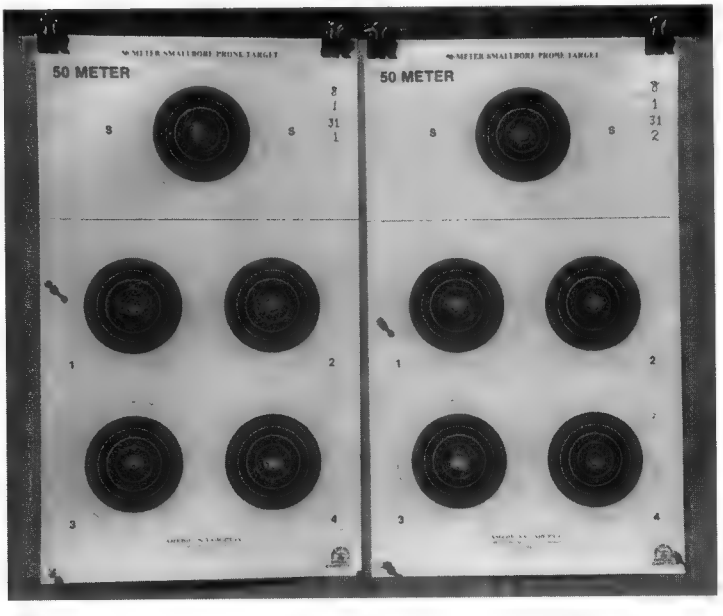


PHOTO #2 My targets from the Sunday 50 meter match at the Roadrunner. My first ever 400 (400-32X) at 50 meters and it won the match.

SEVEN DAYS OF SMALLBORE PRONE

Continued

match, one day is shot with iron sights and one day with scope. Here you get to use scope both days, so it does you no good to offer excuses about old eyes, etc. That being the program, I put my trusty old Redfield 3200 on the rifle, and we all commenced to shoot.

You might guess that with all the frustration of the previous two days I was in no mood to shoot, much less shoot well. You'd be wrong. One of the prime directives of mental training for any sport is "Feast and forget." If you do something good, enjoy it, dwell on it, brag about it; but if you do something wrong, or you have some bad luck, just forget it.

Carlos Hathcock talks about being "in the bubble", by which I think he means that the bubble shuts out all the world around you. When you are in the bubble and about to fire a shot, nothing exists for you but the rifle, the target and the conditions. Maybe I really was in the bubble, or maybe I was just too tired and strung out from the frustration of the previous two days to do much that was wrong.

Whichever, I just laid down on my mat, tried to hold as best I could and concentrated on trigger control. It worked. Forty record shots later, I had fired my first ever clean in the Dewar match, a 400-30X which was good for 2nd Expert. Peter Sands, who ended up with a Master level aggregate after both the Roadrunner and the Wildcat, took First Expert with a 400-32X. If the NRA runs the computer soon, Peter will get a Master card that can't be used in a store. This 40 shot match was won by Bob Tang with a 400-35X with Billy Meek taking first in the "Open class". The "Open" class is the local, Phoenix area, Smallbore equivalent to the Highpower High Master classification. Jim Welsh won first Master with a 400-34X.

Since there are eight, 40-shot matches and three aggregates in the Roadrunner alone and sixteen, 40-shot matches and nine aggregates in Western Wildcat, there is no way I can report on everything that everybody did. The match report for the Roadrunner is six pages single-spaced. The best I can do is try to give you an overall view of what went on and who the ultimate winners were, together with my personal story and, as usual, some outrageous opinions.

Let me tell you why I think these matches are important and why I think you should consider shooting in them if you live in the Southwest. There are not all that many 6400 point matches scheduled across the country. Such a match takes four days and many people are reluctant to take that much vacation time for such a match that is not at Camp Perry. But, for the few matches that are of long standing, such as the Western Wildcat, top shooters come from all over the country and from out of the country. It does not hurt that mid-March is one of the most pleasant times of the year in Phoenix, with temperatures dropping into the 40's at night and rising up to about 80°F during the day, but seldom over that.

When I say top shooters come to these matches, I don't mean just some person who may be the best shooter in Parrott City, Colorado, which happens to be a ghost town. The first year I shot the Wildcat, it was won by Lones Wigger. The next year, 1993, the US Olympic team showed up as did the team from the Army Marksmanship Unit. Steve Goff of the AMU won it that year. The list of Wildcat winners is full of such names.

This year the list of shooters at one or both matches included such names as current and former Palma team members Richard Anthony, Stan Bigham, Ken Dunlap, Bob Jensen, Billy Meek (who is also on the 1996 Olympic team) and Nancy Tompkins-Gallagher. Other names you might recognize included George Stidworthy, who holds many Smallbore records; his daughter and three-time National SBP Champion, Mary S. Sparling; Bob Holtzman, who helped me out in 1993 and was the National Intermediate Senior Champion that year; and Jack Foster, a former Olympian and International champion who was recently selected to the USA International Shooting Hall of Fame. Of course, most of the shooters come from the Southwest, but there were shooters from all over the USA, from Alaska to Arkansas, Indiana, and New York. There were also five shooters from Canada: Clint and Patty Dahlstrom, Peter Page, Arne Sorenson, and Harvey Trace.

What makes an ordinary shooter like me crazy enough to want to come out and try to shoot against such high level shooters? I think of it not as shooting against such people, but rather as shooting with them, mostly in the hope that some of their skill and knowledge might rub off them onto me, that I might learn something. That seems to be what has happened. I know I have gotten better since I started shooting this game.

The weather conditions for the Roadrunner were ideal: warm sunshine and winds that were at worst but gentle

PHOTO #3 The author on the line at the Roadrunner. Bill Smith from Alaska on my left.

PHOTO #4 George Stidworthy and dogs on the line at the Roadrunner. Allen Elliot on George's left.

zephyrs. Scores were high and most people in the Expert class and below shot one or more personal bests. When the first day's shooting was done at the Roadrunner, Bob Holtzman had won the daily aggregate with a 1599-132X. Peter Sands locked up First Expert with a 1595-114X, while I had Third Expert with a 1594-106X, two points above my previous, personal-best, daily aggregate.

The next day, Sunday, conditions were even more benign, and Canadian Clint Dahlstrom won the daily aggregate with his first ever 1600, a 1600-115X! We did not have a proper chair, so we could not properly "chair the winner" in true British Empire fashion.

However, something really strange happened that Sunday, something I have not yet quite come to grips with. As you work your way up the ladder of Smallbore Prone, one of the things you do after you claw your way into the Expert class is to set goals for yourself to shoot a 400 in each of the stages of the standard 1600 point match. After all, you can't even think about shooting a 1600 until you can shoot a 400 in each of the 40-shot matches.

Before coming down to this year's Roadrunner, the only stage in which I had shot a 400 was the 50 yard stage, although I had done that several times. This year I had already satisfied one of those goals by shooting that 400 in the Dewar on Saturday.

Now I needed a 400 at 100 yards and one at 50 meters to complete the set. It did not happen at 100 yards. I tossed a 9 out high on the first target at 100 yards from too much cheek pressure and ended up with a 399-20X. I had one more chance at 50 meters.

All I did was lie there and pay attention to four things: cheek pressure, my hold, the wind and my trigger control; and the shots kept going in the middle. When I was through with the second target, I figured I had a 400-34X. The stat crew saw things a little differently and gave me a 400-32X. People began congratulating me for my good shooting, so I figured I had finally gotten a First Expert. I did not go look at the scoreboard until after the 50 yard match was over. I was Match Winner by two X's!

Miss Penelope later told me she had looked on the scoreboard and was puzzled for a while because she could not find my name for the 50-meter match in the Expert Class.

Now this kind of thing is not supposed to happen. People are not supposed to come out of the Expert Class and flat out win a match against the level of shooters that were on the range that day. I am still trying to figure out how it happened.

This time I remembered that the stat office would give you back your targets after the challenge period is over. I asked for these targets and got them. They are shown in Photo 2. They are going to hang on the wall of my shop for a long time. Yeah, I know, those two shots on the first bull look pretty iffy. I assure you they plug with room to spare. I should have also asked for my targets from the previous day's Dewar match, but I was too excited to even think of that match.

Even though I did not yet know I had won the 50 meter match, I was so happy at getting that 400 at 50 meters that I was not able to concentrate at the level I should have for the 50-yard match and dropped 2 points there. That gave me a 1596-117X for yet another new, personal-best for the daily aggregate.

Arne Sorenson, who had dropped only one point on Saturday, did the same on Sunday, thus outpointing everybody to win the Grand Aggregate and Roadrunner Championship with a 3198-232X. Nancy Tompkins-Gallagher was only one point off the pace to win the High Opposite Sex trophy with a 3197-246X, and Nancy's daughter Michelle Gallagher was High Junior with a 3134-153. In 1995, the High Woman award for the Roadrunner was renamed the High Opposite Sex award after Nancy won the match and Bob Holtzman came in second. Holtzman was the first male recipient of the HOS award.

Billy Meek won the Open class with 3195-256X, and Allen Elliot took First Master with a 3194-234X, just 4 X's over Clint Dahlstrom. The Expert Class Grand aggregate was won by Virginia (Ginger) McLemore with a 3193-211X. The previous October, Ginger won the New Mexico SB Prone Championship at that match in Albuquerque that got called on account of a sandstorm. Peter Sands was Second Expert with a 3191-233X, and I was Third Expert with my 3190-223X. All of these scores are well above the 99.5% threshold for the Master class which would be a 3184 for 320 shots. This would change soon for most of us in the Expert Class when we would have to take the scopes off our rifles and begin shooting the Wildcat with iron sights.

CHANGES AT BEN AVERY RANGE

On Sunday evening, we hooked up the trailer and hauled ourselves, the trailer and the dog up the Ben Avery Range north of Phoenix. We just managed to slip in before everything was locked up tight for the night. The Ben Avery Range, once known as the Black Canyon Range, was operated for many years by Maricopa County. The county wanted to be shed of the facility and managed to convince the Arizona Game and Fish Commission to take it over. With the change in administration, came a bunch of changes in operational procedures, including how and when you can get into the campground.

Under the Maricopa County administration, the campground was open all the time, and there were people living in the campground who had no interest in shooting, but who were there simply because it was cheap compared to permanent housing in Phoenix. Under Arizona Game and Fish (AG&F), you cannot get a space in the campground unless you are there for a match, and the campgrounds are locked up at night when the ranges close down. There is a gate with a combination lock that campers are given the combination to, but using it is pretty inconvenient when you want to go out to eat or get some groceries. In fact some of the AG&F employees are leery of letting anyone come into the campground more than one day before the match in which they are going to shoot. I expect that all these things will get smoothed out in time.

Monday was a dead day as far as shooting was concerned; the Ben Avery ranges are closed on Monday and Tuesday, so we went shopping, first down to Walt Berger's for some bullets, then back up to Bell Road to prowl used bookstores for goodies Miss Penelope likes to read and to look in other stores of interest — targets of opportunity.

Tuesday turned out to be a dead day as well. Usually it is a practice day before the team match, but this year AG&F wanted a $4.00 range fee for anyone who wanted to practice. I figured I was shooting pretty well without practice, so I demurred.

THE WESTERN WILDCAT 6400

The first formal day of the Western Wildcat is Wednesday, on which there are two, two-person-team matches. An iron sight match in the morning and a scope (or any-sight) match in the afternoon.

In previous years, these matches were shot in the Dewar format, but on the special Outdoor-Metric targets on which the scoring rings are even smaller than the rings on the standard 50-meter target. This year the Dewar course was used, but with the standard targets.

Last year, John Van Marter from Los Alamos and I teamed up and took First

Continued on next page

SEVEN DAYS OF SMALLBORE PRONE

Continued

Expert in the any-sight match and were in the middle of the pack with irons. This year, Ginger McLemore and I teamed up and took Second Expert with irons. We dropped into the middle of the pack in the scope match because I managed to crossfire not once, but twice. That cost us 4 penalty points and one place in the standings. You know what they say about crossfires: There are those who have, and those who will, ... again.

The individual matches of the Wildcat begin on Thursday. The first day is with iron sights. I was trying something new this year. In February, I had gone down to Los Alamos to visit Van Marter and fire some tests with moly-coated bullets at longer distances than I have on my home range. While I was there, he had shown me something that was new for him, a Gehmann, variable-focus diopter that fits in your rear sight. I decided I needed one, and before leaving to come to Phoenix, I called Jack Foster, who runs Accuracy International, determined that he was coming down to shoot the Wildcat, and got him to bring one of these miraculous devices down for me. This diopter allows the shooter to bring his point of natural focus to the optimum distance for the size of the rear aperture being used. It worked well enough for me that I shot some of the best scores I have ever shot with iron sights that Thursday, scores which put together gave me a new, personal-best, iron-sight aggregate of 1587-97X.

The weather conditions had continued to be so benign we all wondered if Murphy had perhaps taken an extended trip to another hemisphere. Most peoples' scores continued to show it, but not mine. Somehow on Friday, something went awry; I had position problems, or the nut behind the buttplate got loose, or something. With a scope on the rifle, I picked up no more points and only one more X than I had gotten with irons the day before, a lousy 1587-98X. For those nice conditions, I thought my score should have been in the mid 1590's. I guess my comfort level must have really gone up with all the success I had had down at the Roadrunner.

AN ILL WIND

On Friday, the weather prognosticators began muttering about signs and portents of "something coming" that would arrive Friday night. Saturday morning we got up to temperatures that were maybe 20 degrees lower than the day before and with a fitful, switchy-twitchy wind that was gusting up to 25 to 30+ mph. This would definitely separate those who were only hardholders from the wind-dopers. Unfortunately, this wind did more than just affect our shooting.

Sometime in mid-morning on Saturday, word came in that Shankha Kalin and his father, Werner Kalin had been killed in a plane crash. Werner was piloting a light plane, flying Shankha to Phoenix from Garden Grove, California so that Shankha could shoot in the last two days of the Wildcat. Needless to say, this cast a pall over the proceedings from that point on. When we lose juniors, we are truly diminished. Sometimes words are just not adequate. In the spirit of all competitors, we continued to strive and shoot even as we mourned.

The problem in trying to shoot with iron sights in the sort of messy wind that front brought us is that the hand that turns the windage knob is usually the hand that has your trigger finger on it, and you can't turn that knob fast enough and get back down to the trigger quickly enough to get a shot off before the wind has changed again.

This problem is compounded for most Smallbore shooters because they almost universally want to shoot a sighter or two before they go back and shoot a record shot when the wind has changed. In fact, what they really prefer to do when they see a wind change is go up to the sighter target and shoot a shot while holding center, make a sight correction from where that shot printed, and fire another sighter to confirm that the correction is correct before going down to shoot any more record shots.

Many Smallbore shooters use this pattern so often that it becomes so much of a habit that they never really learn to judge the wind well enough to look at a condition change, say to themselves, "That's worth 3 clicks left", make the correction on the sights, and go ahead and shoot it on the record target without ever shooting a sighter.

We old Highpower shooters are often sneered at by long-time Smallbore shooters who say things like, "When you do that you are just guessing. You should never guess in Smallbore."

My reply is, "Highpower shooters don't make blind guesses, we make educated guesses."

In Highpower, you only get 2 sighters and they are your first two shots. When the wind changes after that, and you can bet it will, you had better have a pretty good idea of what those changes are worth because everything is for record. Most Smallbore shooters think that having only two sighters is ridiculous, but they are totally incredulous when they are told that there are no sighters at all in DCM Leg matches. Their reaction to that is simply that it does not compute; it does not parse; please reboot.

Is all this just blather and braggadocio on my part? Well, consider this, we had all that nasty wind on Saturday and it continued on through Sunday. On Saturday, I was still trying to work out whatever problems I was having with my position and shot a 1577-75X with iron sights; but 10 of those 23 points I lost were out for elevation but were well in for windage. Actually the 1577 was not too bad a score within the Expert class that day because everybody was having problems with the wind. What ticked me off was those 10 points that were out for elevation but were well in for windage; I

PHOTO #5 Shooters standing in the sun trying to get warm on Saturday morning of the Wildcat.

have just got to educate my cheek to know what the proper amount of pressure feels like.

On Sunday with a scope back on the rifle so that I could hold off rather than having to make sight changes, I somehow managed to get it all back together. The wind was still being nasty, so I shot a 399-28X in the Dewar, losing 1 point to a sudden wind switch. Then came the 100-yard match, the only one of the 40 shot matches I had not yet managed to "clean". I wanted a clean in the worst way. I worked really hard for it in messy conditions, and I got it! I got my targets from that one too; they are in Photo 6.

I got that 400 by shooting "safe shots" for 10's rather than trying for X's and my X-count showed it. I almost lost a few that were out on the lines, but none of them required a plug. It was easy to see they were all 10's. I finally had my 400 at 100 yards, a 400-19X. Second expert was a 399-29X. I'll take the point over all the X's, thank you.

There were not as many 400's shot in that match as usual because of the tricky conditions, with all kinds of shooters who are far better than I am dropping points right and left. Are Highpower shooters crazy? Sometimes, ... like a fox.

When the shooting stopped on Sunday, Allen Knowles emerged as the winner of the Wildcat having dropped only 6 points over the four days with a 6394-530X. Billy Meek won the Open class with a 6394-505X, and Samuel Thoman was top Master with a 6370-434X. Peter Sands won the Expert class and held onto his Master class average with a score of 6366-413X. High Junior was Elisa Browne with a 6295-335X. Me, I ended up 7th Expert with a new personal best of 6346-363X.

There were five shooters who shot the special senior package, for which you have to be at least 60 years old. These shooters got to shoot with a scope on all four days. Carl Retzlaff won this division with a fine 6375-444X.

A MODEST PROPOSAL

I am going to step out on a big, tall limb here and probably saw it off behind me when I say this, but I think that Smallbore Prone would greatly benefit from a limitation in the number of sighters allowed. Highpower shooters are constantly commenting on how many perfect scores are shot in Smallbore prone, way too many in their view.

In the Highpower game, the number of 500's that have been shot in 50-shot matches is very small. Furthermore, all the 500's that have ever been shot in sanctioned matches were shot in team matches with coaching. No one has yet managed to shoot an 800 in an 80-shot match. Back in the 1960's when the Highpower world was using the 5-V targets, and it got to the point that scores of 250 with high V counts became common, a change was made to the 10-X target with smaller scoring rings. The effect was that scores on the so-called decimal target immediately went up to levels above what would have been records on the 5-V target; the shooters rose to the challenge. My point is that I do not think that limiting the number of sighters would significantly lower scores, at least not for long, and certainly for no longer than it would take for the shooters to become better judges of the wind than they are now.

Smallbore prone would be a different and far more challenging game if you only got 2

Continued on next page

PHOTO #6 My targets from the Sunday 100 yard match of the Wildcat. A 400-19X that took First Expert.

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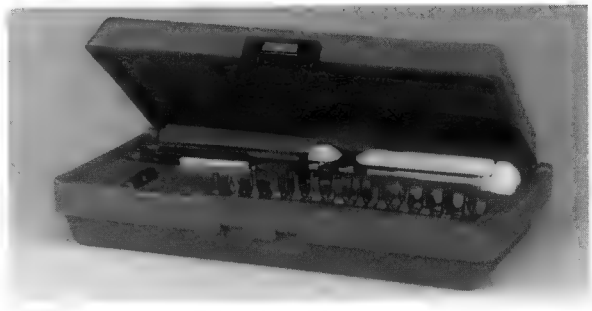

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SEVEN DAYS OF SMALLBORE PRONE

Continued

sighters, or even 5 for each 20 shot target. Take all the warm-up shots you want into the berm, but only 2 or 5 on the sighter bull. If that were the rule, you would have to know what different wind conditions looked like and what they were worth. You would even have to know your zero for your rifle for each distance. Guess what? I don't know my zero on my 52C for the different distances. The rifle gets rezeroed every time with all those unlimited sighters, so who cares. But I think I know what a 3 click change looks like; and when I think I see one, I put that dope on the sight and shoot it, for record without bothering to go to the sighter target. I may not get an X, but I don't get a lot of 9's. Sure, I get more than I like, but I only missed making Master by 16 points this year, and I lost a lot more than 16 points to bad elevation. Maybe if I ever make Master in any of these games and get really good, I'll change my tune. Maybe I don't understand enough of the subtleties of Smallbore yet, but I don't think so. I know that I lack certain skills and know (or at least think I know) that if I manage to gain and refine those skills, I can compete at the top level in this game.

So here is my challenge to all you Smallbore shooters who do not also shoot Highpower: Try shooting practice matches with only your first two shots as sighters for each 20 record shots. It just might make you a better judge of the wind. Or better yet, take up Highpower. You might even find that you like it! In any event, it will definitely teach you more about judging the wind than, "Oops, I see a change, time to shoot some sighters." You might even consider asking your rules committee to limit the number of sighters allowed per target.

I took up Smallbore Prone because I knew I needed what it could teach me. It has taught me much, and I know I still have much more to learn. But each game has different challenges and something different to offer. I think that wind judging is one of the things that Highpower can possibly teach the Smallbore shooter. It is worth a try, isn't it?

Till next time,

Keep'em in the center,
Randolph Constantine
47951 U. S. Hwy. 160
Bayfield, CO 81122

BENDING BULLETS

by

Dave Whitford

Let's assume that an accurate cartridge is a straight cartridge. Can we agree that a banana-like round skews its bullet with respect to the bore's centerline and might send that bullet well out of the target group? Why else do we go to so much trouble — turning case necks, using bench-rest bullet seaters and case-preparation techniques — to help ensure that the ammo we produce comes out straight?

What if, despite our best efforts, some of our ammo ends up crooked anyway? We put a loaded round on a coax checker and — OOPS! — 0.006" total indicated runout (TIR). Do we use the round that way, or what? Is that round acceptable? I think not. I shoot high-power matches, not bench-rest, so a round like that doesn't much bother me for offhand shooting at 200 yards, where the 10-ring is about four minutes wide anyway. At 600 yards, however, where the 10-ring shrinks to a wind-whipped two minutes, and the Xs to about a minute wide, I want the best ammo available. I want ammo that's straight within about a thousandth TIR, tops.

Because not all my ammo comes out of even a bench-rest bullet seater that straight, I bend it with my home-made "neck wrench" (see Figure 1) until it is that straight. It's my final reloading step. It can even be done while keeping company with the rest of the family in front of the TV. In that way, it scarcely seems to require any extra time.

Is this extra trouble worth the effort? I surely think so. According to my informal testing, it can improve accuracy as much as 25%. Here's why I say so:

I had one really stubborn accuracy problem with the only new rifle that I ever bought, a Remington Model 700 Varmint Special in 6-mm Remington. Soon after buying this rifle, I also bought 1000 Winchester 80-grain pointed-soft-point bullets, which are handsome missiles at a moderate price. After trying dozens of different loads with these bullets, glass-bedding the stock, free-floating the barrel, lapping the bolt lugs, and generally tuning things up, the best that I could get this rifle to shoot was 1-1/4" to 1-3/8" groups at 100 yards. I was not a cheery rifleman.

Then Jim, my friend and competition mentor, showed me how to "bend my bullets" ... that is, straighten the rounds so that they would indicate little or no runout on a coaxial checker. Finally — and suddenly — the rifle began grouping the Winchester bullets that it so much deplored just inside an inch. With respectable bullets like Remingtons, Sierras, and Hornadays, AND the case-straightening technique, 7/8" groups became typical, and 3/4" groups sometimes appeared. My confidence soared.

As a postscript, that only moderately accurate Remington helped take me from NRA Marksman to Expert with its original barrel. With its replacement Hart, 8-twist, .243 Winchester barrel, a metal stock, and VLD bullets at 600 yards, the rifle has proven that I can never, ever blame the rifle (as though I ever could!). I do still straighten the ammo for the rifle, and Figures 2 through 7 show how.

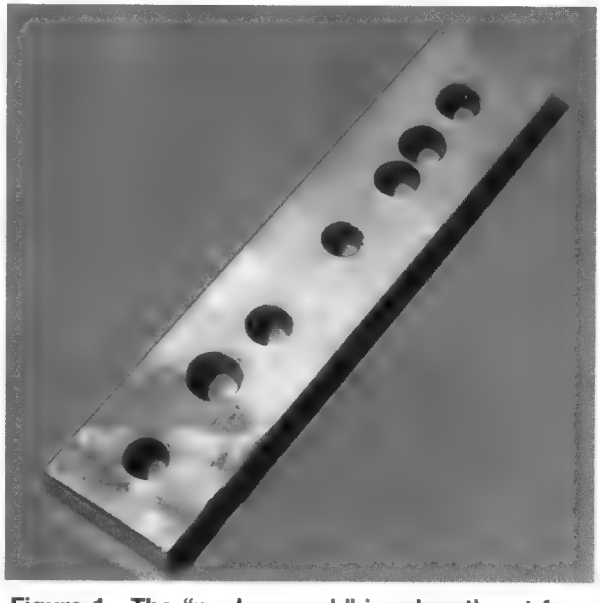

Figure 1. The "neck wrench" is a length cut from 1" x 1/4" soft aluminum bar stock from the hardware store. I drilled a hole to just barely accommodate the neck of a loaded round for each of the calibers that I reload.

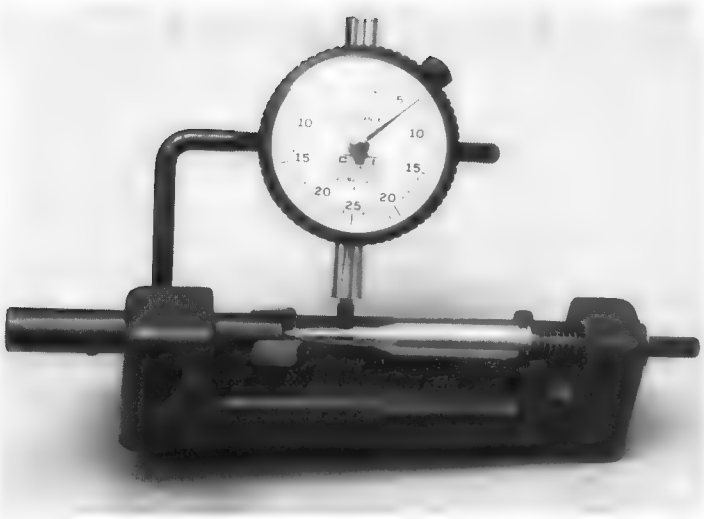

Figure 2. Checking a freshly loaded round on the coaxial checker indicates a total indicated runout (TIR) that exceeds 0.006"

Figure 3. Inserting the round through its corresponding hole in the neck wrench, I take care to ensure that I don't bend against the shoulder of the cartridge case.

Figure 4. Orienting the round in the neck wrench in the same way that it comes off the coax checker, I take note of the head-stamp orientation and give a firm push with my thumb.

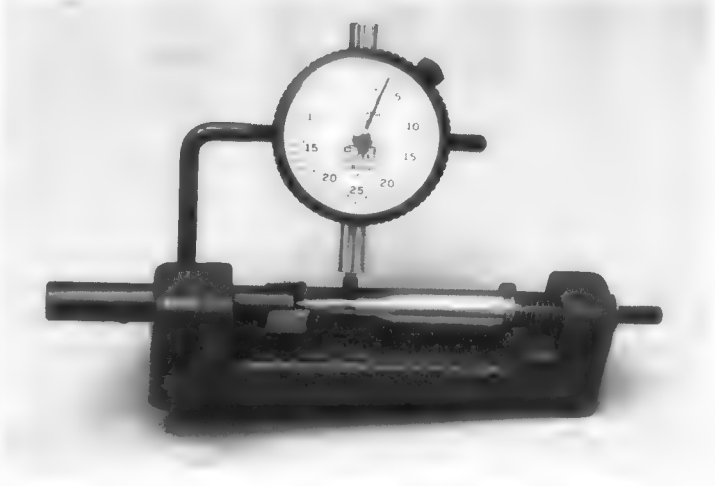

Figure 5. Testing the round again on the coax checker, I discover that I still have almost 0.003" TIR.

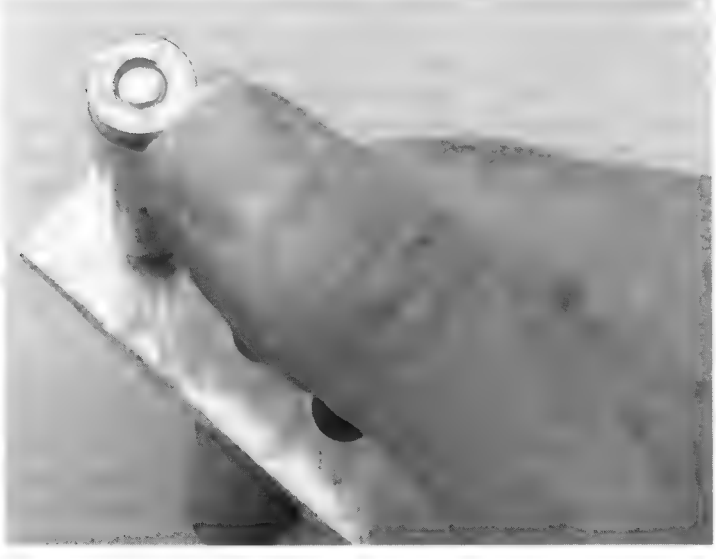

Figure 6. OOPS! The head-stamp orientation tells me that I pushed too hard the first time and bent the neck past straight and toward crooked in the opposite direction. A gentle thumb nudge this time should fix this.

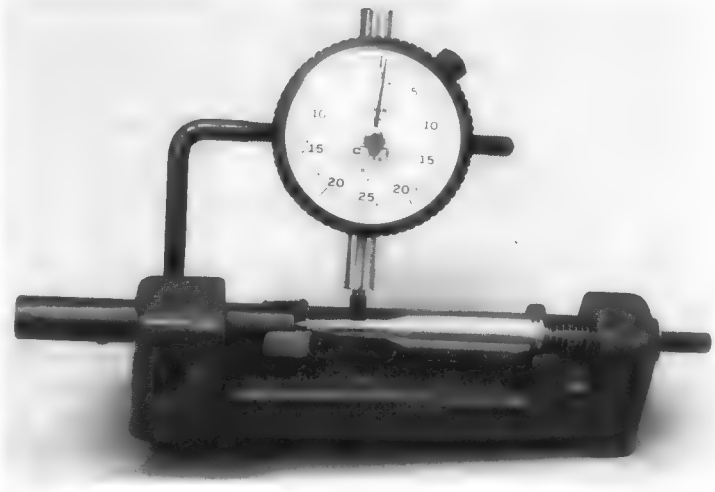

Figure 7. BINGO! The round checks in at less than 0.001" TIR. My experience tells me that good ammo, straight within 0.002" TIR, should shoot quite well. Be prepared to make more than one or two bends on stubbornly crooked rounds. On the other hand, perhaps a third of your ammo will be straight enough without bending it.

LOW BUDGETING FOR A HUNTER RIFLE

by

Bill Bartram

Benchrest shooting has several types of applications, ranging from rimfire to centerfire competition, each different yet with aspects in common. They're all tough and they're all exacting. It's basically a no nonsense sport, in which the shooters who participate take their sport seriously, but sometimes view their own individual efforts with a certain degree of humor. (Editor: Or hysteria).

When you first start out in benchrest, it's difficult to decide which area of the sport to try first. They all have great appeal, but probably you'll be influenced by areas in which your friends compete and how far you have to drive to the various competitions. Your current financial resources almost always have something to say about it, as well.

One of these great sports is called Hunter Rifle by the NBRSA and Hunter Class by the IBS. Both organizations have very similar rules with only a few real differences: (a) The NBRSA does not allow 22 caliber chamberings, where the IBS does in the separate Varmint-Hunter Class. (b) The NBRSA allows the use of custom-made actions while the IBS does not. (c) The NBRSA requires the case capacity to hold a minimum of 45.5 grains of water weight, while the IBS requires a minimum water weight equal to or exceeding that found in a 30-30 cartridge. In checking the water volume weight of five Federal once fired cases, I found they ranged from 42.8 grains to 45.3 grains. (d) The NBRSA does not require a safety on the competing rifle while the IBS does require one. (Editor: A rule change removing the safety requirement is to be voted on at the January 1996 Winter Meeting of the IBS).

I'm sure I share a common problem with quite a bunch of *PRECISION SHOOTING* readers. I'm intrigued with the art of accurate rifle shooting, but must approach it with a limited budget in mind — the more in mind the better, according to my wife.

I sincerely wanted a rifle for NBRSA Hunter Rifle and happen to have a friend, Allen, who is deeply involved in benchrest shooting and builds some fine competitive rifles for himself. He offered me a straight forward deal. If I'd do some work for him around his property that he didn't particularly like to do, he would build a rifle for me. I would provide the receiver, bolt and trigger and Allen had a used Hart barrel in 30 caliber he'd give me.

I understood, from the outset, that my Hunter Rifle wasn't going to be considered a top of the line competition rifle. However, it would, in all probability, shoot better than I could as a rookie and it would be competitive. A major point to me was that it would be a rifle I could afford.

I followed the advertising in all the local papers, visited the gun shops, hit the gun shows, etc., looking for a reasonably priced Remington Model 700 or Model 722. The short action was a must, so I had to narrow the search to chamberings for 223, 243, 300 Savage or the 308 cartridge. The shorter action was desirable because it is probably a bit stiffer than the longer ones, as well as being a bit lighter in weight. When you're restricted to a ten pound weight limit for the complete rifle, it's more desirable to have the weight in the barrel.

Allen spotted a Model 722 in the paper so we went to take a look at it. It was chambered in 300 Savage and had seen lots of use, but was in reasonable condition. The rifle featured a leather sling and a four power scope that was barely usable. The seller even offered to throw in about a dozen handloaded cartridges for the grand price of $200.00.

I purchased the rifle and fired the handloads the next day to check the soundness of the gun. No problems were encountered and I even managed a five shot group of about three quarters of an inch. I had the beginnings of my new Hunter Rifle!

There wasn't any big hurry in putting the rifle together as we were several months from the shooting season. Plenty of time to consider which scope to use, the brand of stock, mounts, rings and so on.

Allen tore the rifle down and the normal blueprinting was administered to the action. The bolt face checked out okay, so it was left alone, but the locking lugs were lapped to the receiver.

We had some interesting talks and discussions about the philosophy of gunsmithing work needed to make rifles competitive and why that work needed to be done. Exactly what happens, mechanically, just prior to, during and immediately following the trigger pull? What are the effects of the gunsmith's work and how can it be measured? Perhaps you, too, will find the subject matter to be of some degree of interest.

Squaring the bolt face sounds as though it's something really necessary to have done doesn't it? It sounds important. How could you possibly have high expectations of accuracy if you knew for a fact that your new rifle did not have a bolt face that is square?

The first question that comes to mind is square to what? Most often we're told that the bolt face must be square to the center of the bore. That might be true when the rifle is at rest and unloaded. At that time the bolt is the only piece of the action that is loose. The cartridge case is what forces the locking lug surfaces to mate. When fired, the harmonic vibrations travel through the steel much faster than the bullet can travel. Does the relationship between the bore center and the bolt face stay the same throughout the vibration process? I have no idea how it could be measured or proved.

A more practical logic might be to cut the chamber end of the barrel square to the threads on the barrel and to turn the bolt face parallel to the chamber end of the barrel. If the barrel oscillates uniformly from shot to shot the rifle will shoot uniformly.

The second point of gunsmithing philosophy is to analyze the need to lap the locking lugs and what is accomplished when you do so. Every serious shooter

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and gunsmith knows that lapping does help accuracy considerably, but why does it work?

Try to mentally picture the entire scenario in slow motion just prior to, the exact instant of, and immediately following the pull of the trigger; those few nanoseconds between trigger release and the start of firing pin motion. The camming action has taken place. The bolt is cocked. The firing pin is positioned in its rearmost location with the heavy spring pressure desperately wanting to drive the firing pin forward. The only thing preventing this from happening is the striker being held in place by the trigger sear.

This cocking action wedges the rear of the bolt up, forcing it against the top of the receiver. The wedging effect forces maximum pressure against the lower locking lug mating surfaces and minimizes the pressure on the upper locking lug surfaces. These unequal pressures do their best to change the position of the mating surfaces in the process.

A couple ounce trigger pull releases the compounded leverage on its mating surfaces, the lever moves slightly forward and the sear is allowed to drop down. The sear is no longer supporting the striker so it, in turn, also drops. For the shortest amount of time imaginable, every part of the bolt assembly is in a state of suspension. Everything is entirely static. There is absolutely no pressure or movement anywhere inside or outside the body of the bolt.

Then all heck breaks loose. The thrust of the heavy spring tension violently throws the firing pin down the hole in the center of the bolt. The release of tension encourages the firing pin spring to bounce off the walls of the hole; the firing pin is bouncing around as well as moving forward and the bolt body is also in motion. All these movements are creating vibrations. Again those vibrations are moving through the steel at a much faster rate of speed than the firing pin can travel down the hole. Those vibrations will attempt to dislodge all those carefully hand fitted parts of the action.

Lapping the locking lugs to their respective surfaces in the receiver is merely an attempt to reduce or eliminate as much misalignment as possible for this short interval of time.

While we're already in this area, there's one more factor that can be of real importance in keeping the vibration induced problems to a minimum during the transition time of trigger release and firing pin travel.

When brass is properly fireformed to the chamber it fits very snugly. The degree of snugness can be detected by the felt resistance on the bolt handle when opening and closing the bolt. Experimentation and experience will tell you when the feel is correct.

When the fit is correct, the cartridge case becomes a solid link between the bolt face and the (chamber shoulder area) barrel. Properly fireformed brass minimizes movement of the bolt face during these nanoseconds of otherwise static time. Brass that fits too loosely offers no resistance; too long, and it can actually cause a very noticeable amount of locking lug bind and tension. This is the reason it's important to lubricate the mating surfaces of the locking lugs.

There are several options that deserve consideration when choosing a trigger for a competition rifle. The choice ranges from the factory original to the truly fine custom-made one. We came up with a Timney Sportsman trigger which Allen converted to a three lever.

Once a person has used and become accustomed to a crisp trigger of two ounces, or so, you are spoiled for life. You'll never want to go back to a creepy, crawly, gritty, hard pulling trigger for any type of target work.

Adding a third lever to the Timney Sportsman trigger is a major improvement. It transforms it from a good product into a rather sophisticated piece of machinery. Even by using a jig to match up the mating surfaces as precisely as possible, it still requires a craftsman, with a certain degree of skill and experience, to do the modification correctly.

The mating surfaces are in contact by the thinnest of margins and can be disengaged if treated roughly. If those mating surfaces pick up dirt or powder residue, the bolt may not cock and the fast, hard slamming of the bolt handle closed could possibly jar the trigger enough to cause it to fire. As is the case of any trigger suitable for precision accuracy shooting, the shooter must use care when utilizing it.

Custom triggers are probably more desirable to many competitors. The downside is that they can be almost three times the cost of a good three lever modification.

The used Hart barrel had less than 500 rounds fired through it. It was a tight 308 bore diameter, featured a one in fourteen inch twist rate and had not been tapered. For my rifle application the barrel was cut off at the chamber end to a length of twenty two inches. This would allow a fresh chamber to be cut and still be long enough for one or two future rechamberings.

Here in the Pacific Northwest area, Hunter Rifle competition is conducted

A close up view of a three lever trigger conversion. A close look at the upper trigger housing hole shows the degree of mechanical engagement between the striker and the sear.

under NBRSA rules. Their rule book states that barrel taper is 1.250 inches maximum O.D. at the chamber end and .750 inch maximum at the muzzle of a hypothetical twenty six inch long barrel. The Hart barrel was dimensioned out at 1.245 inches down to .785 to be on the safe side of the rule book. The muzzle end was also given a newly cut crown.

Competing with a ten pound rifle chambered in 308 Winchester, and using the free recoil method of shooting, can get to you during a long match. If you don't shoulder the rifle uniformly for each shot and occasionally misjudge cheek placement in relationship to the stock, you can get the heck slapped out of you. Even when you manage to do everything correctly, whether you want to admit it or not, recoil does take its toll. The name of the game is to punch holes in paper. There just isn't any good reason to absorb any more recoil than is necessary.

The NBRSA requires a minimum of 45.5 grains of water for case capacity of a Hunter Rifle. The 30 caliber bullet offers a slight, but definitely worthwhile, advantage over smaller bullet diameters; a better chance to touch the X on a marginal ten ring hit.

Allen has recently rechambered his own Hunter Rifle to a smaller case capacity in a very economical manner. It didn't even require the purchase of a new chamber reamer. The barrel was set back and rechambered with his tight chambered 308 Winchester reamer, however,

Continued on next page

LOW BUDGETING FOR A HUNTER RIFLE

Continued

he stopped the reamer .140 of an inch short of the normal cartridge length. The new chambering (308 minus .140) shoots every bit as well as his full length 308 Winchester ever did, and that was pretty darn good. The reduced felt recoil was quite noticeable, making it considerably more comfortable to shoot.

I decided to have my Hunter Rifle chambered for this new cartridge as well. The neck is a nice snug .332 diameter. We ordered a Lee Six stock with a 2 1/4 inch forearm. The stock weighed 1 lb. 5 1/2 oz. as it came out of the box. That's pretty light weight which is great; it allows more weight in other areas.

The magazine was shortened to hold two rounds of ammo as required by NBRSA rules. A bedding job soon followed to complete the rifle.

At the 1995 *SHOT SHOW* I spent some time at the Ultra-Light Rifle booth. (Ultra-Light Arms Inc., PO Box 1270, Granville WV 26534). I noticed they offered Remington Model 700 type trigger guards, either anodized or in the white, for very reasonable prices. I ordered one for my new rifle.

The NBRSA differs from the IBS by not requiring a safety for Hunter Rifle competition, so I chose not to use one on my rifle. I do not plan to use the rifle in any type of hunting situation and the bolt is removed from the receiver when not actually being shot, so a safety is rather redundant. Another reason is because a safety is a bit difficult to retain with a three lever conversion on the trigger. It can be done successfully if needed, but it's kind of extra baggage.

The bolt stop was also left off as unnecessary, as well as not being desirable on a competition rifle. You must remove the bolt from the receiver constantly throughout the match, for safety between firing sessions, and to clean or transport the rifle. A spring loaded or mechanical bolt release isn't difficult to conjure up, but I'd just as soon not have to bother with one.

The ejector was eliminated from the bolt face. On a standard rifle it serves a purpose, but not in competition application. It's no effort to pick the fired brass from the bolt face. The ejector has a bad habit of sometimes causing problems. The ejector is a spring loaded rod that is constantly trying to push the loaded cartridge into a bind within the chamber walls. Logic should tell you the whole idea of accuracy starts by pointing the bullet as straight down the bore as is humanly possible. The ejector is designed to be at cross purposes to this reasoning.

A weaker spring is sometimes used in the ejector to reduce the risk somewhat, but why take a chance? It's another area of decisions to be made when making up a competition rifle.

The reduced recoil of the 308 minus .140 cartridge allows a rather thin recoil pad to be used on the stock. Mine was manufactured by cutting a one eighth inch plate from aluminum and fitting it to the butt of the stock. Then a similarly shaped pad of dense foam rubber was put in place with double faced tape.

At the '95 *SHOT SHOW* I also located a set of scope mounts and rings by J.B. Holden Co. (PO Box 320, Plymouth, MI 48170). Two features about this product appealed to me: (a) It's a two piece scope mounting system with each base and ring in one integral piece. (b) It's strong and trouble free. A no nonsense product.

The scope was one of the easiest pieces of equipment to choose. Almost everyone I asked recommended the silver Burris HBH scope with dot. The Burris HBH (Hunter Bench Rest) scope is the manufacturer's answer to many requests from competition shooters and is made especially to compete in Hunter Rifle/Hunter Class competition. The silver anodized color supposedly absorbs and retains less heat during the shooting sessions, which, in turn, reduces warpage and distortion. The dot rests on fine crosshairs and each click represents one eighth inch bullet impact change at 100 yards. Six power is the maximum allowed for competition. The clarity is good with plenty of eye relief for shooting glasses. The objective lens is 44 mm, in size, which is ample for all but the worst of light conditions. The HBH scope features parallax adjustment. It's a good product.

After gathering all the parts and pieces

Note that the ejector has been removed from the bolt face.

There are several points of interest in this photo: (1) Burris 6X HBR scope. (2) Shortened magazine. (3) Three-lever trigger. (4) Ultra Light Arms trigger guard. (5) J.B. Holden scope mount/rings.

The engraving on the barrel says "Hart-Bench 308-140 332 NK". A Hart barrel, gunsmithed by Allen Bench. 308 minus 140 cartridge with a 332 neck.

of my new Hunter Rifle, it weighed in at 9 pounds 9 ounces, including the scope. This gave me some margin, under the 10 pound maximum weight, to fill in the pits and blemishes on the stock with plastic filler and to apply a paint job. On second thought, I'd better add a bit of weight.

I drilled a hole in the foam at the back end of the stock and glued in a few cast bullets, to bring the weight closer to the maximum allowed. This made the rifle a bit better balanced and made it easier to adjust those minute twitches on the bags.

The cases for the 308 minus .140 can be made up from several parent cases including 308 Winchester, however, the most ideal method is to use 300 Savage brass. The maximum length for a 308 Winchester cartridge is 2.015 inches. Subtracting .140 of an inch leaves a maximum length of 1.875 inches for the 308 minus 140. Brand new 300 Savage brass measures about 1.860 to 1.865 inches. After fireforming the newly formed 300 Savage brass, the final length is about 1.870 to 1.84. That's almost ideal for the new cartridge. One pass through the sizer die, turn the necks, fireform and you are done.

To start with, Allen made up some new brass for me with his sizer die and the necks were turned to eleven thousandths of an inch thickness. This allowed two thousandths of an inch total clearance.

I sorted through my accumulation of full length 308 Winchester sizer dies and found an old RCBS die that would reduce the neck diameter about two thousandths of an inch on a fired case. Most often a standard sizer die won't even touch the neck when they've been turned down to these measurements. Two thousandths of an inch tension on a seated bullet sounded about right for this type of use. The sizer was a good fit in the shoulder/body junction, too.

The sizer die was set up in the lathe and 140 thousandth of an inch was cut off the bottom. Some dies are surface hardened more than others, but this one cut cleanly. It's a trial and error basis. The sizer now looks to be a bit stunted with a 2.638 overall length, but it works fine. When screwed down solidly on the shell holder, it forms new brass very well. When backed off a bit from the neck/shoulder junction, it does the sizing job correctly on fireformed brass. The seater die is my standard 308 Winchester by Neil Jones.

In the early stages 308 brass was used to reform into the 308 minus .140 brass, as that's what was on hand, but it's considerably more work than using the 300 Savage. IMI 308 brass was also tried and abandoned as being too soft. It would often wrinkle in the neck area. We also tried Winchester 308 brass and obtained good results with it; no problems were encountered. However, the bottom line conclusion is that unless you have a particular reason to use 308 brass, the best advice is to stay with the 300 Savage. It works very well and is a lot less effort.

I used Winchester 300 Savage brass for my project and, when finished, I decided to check it out for weight and volume uniformity. I randomly chose five pieces of newly formed brass, inserted already

Continued on next page

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LOW BUDGETING FOR A HUNTER RIFLE

Continued

fired primers in each, then weighed each case. Next I filled each case with water, level to the top of the neck, and weighed each again. The following chart reflects my findings for volume weight.

	EMPTY WEIGHT	FILLED WEIGHT	VOLUME WEIGHT
a.	164.6 gr.	214.3 gr.	49.7 gr.
b.	164.2 gr.	214.2 gr.	50.0 gr.
c.	164.9 gr.	213.9 gr.	49.0 gr.
d.	164.5 gr.	214.4 gr.	49.9 gr.
e.	165.1 gr.	214.3 gr.	49.2 gr.
	823.3 gr. Total	1071.1 gr. Total	247.8 gr. Total
	164.66 gr. Average	214.22 gr. Average	49.56 gr. Average

Comparison note: A full length 308 Winchester case has a volume water weight of about 56.2 grains.

Procedure tip: A few drops of detergent soap added to the water makes it much easier to tell when the water is level with the rim of the neck. I'm told that the detergent breaks down the surface tension of the water.

The grand scheme behind weighing for water volume on the newly formed brass was to establish a median. I thought it might be interesting to check water volume weight on those same cases after fireforming to determine how much expansion could be measured. I kind of wish now that I hadn't dropped that box of loaded ammo before I got the chance to fireform it. Besides bringing back memories of playing the Pick-Up Sticks game when I was a young lad, I didn't have the slightest idea which of those fifty fireforming rounds were the five I had measured for the earlier chart. There was nothing to do but to complete the fireforming session as planned.

Returning home I randomly chose five pieces of fireformed brass and proceeded to duplicate the same test for water volume weight as before. The results of this second test are as follows.

	EMPTY WEIGHT	FILLED WEIGHT	VOLUME WEIGHT
a.	164.2 gr.	214.5 gr.	50.3 gr.
b.	164.7 gr.	214.6 gr.	49.9 gr.
c.	164.6 gr.	214.2 gr.	49.6 gr.
d.	164.5 gr.	214.3 gr.	49.8 gr.
e.	164.5 gr.	214.5 gr.	50.0 gr.
	822.5 gr. Total	1072.1 gr. Total	249.6 gr. Total
	164.5 gr. Average	214.42 gr. Average	49.92 gr. Average

The fireforming only expanded the brass enough for an increase of .36 grains of water weight. I was a little surprised as I had guessed the increase might exceed half a grain or more. The real point of interest is the 308 minus .140 fireformed brass reduced water volume weight 6.28 grains under the full length 308 Winchester cartridge. Enough for a significant felt recoil reduction while maintaining a safe margin over the minimum rule requirement of 45.5 grains.

I was also surprised when weighing both groups of randomly selected brass that they all weighed amazingly close to one another. In fact, they were nearly identical. I had to find out if this was a fluke or if I had lucked into something, so I weighed all the rest of that 100 rounds of brass. The lightest weighed 163.3 grains and the heaviest 165.5 grains. The vast majority was within a one grain variation. This is one of the most uniform groups of brass I've had the pleasure to experience. I won't attempt to explain my good luck, but I fully intend to take advantage of it.

When the barrel was chambered Allen made up an excellent tool for reloading. He used a short piece of old 30 caliber barrel and partially chambered it, cutting it off right where the shoulder junction touches the body. This particular tool is about one and three quarters inches long and about .650 inch in diameter. Actually the tools is an exact duplicate of the neck and shoulder section of the chamber in my rifle. The throat and leade, of course is also duplicated.

The dummy chamber tool enables me to determine the necessary bullet seating depth to obtain exact zero to the lands of the barrel. This is accomplished in complete safety as the round never enters the rifle. (You wouldn't use a live round anyway, would you?) Smoke the length of the seated bullet, enter the round into the dummy chamber and rotate it with finger pressure. When the lands cut completely through the smoke, but don't leave a mark on the bullet jacket, you're at zero clearance. Once the zero is determined it's simple enough to adjust the seater die stem length for best accuracy. As you encounter throat erosion in the barrel through hard use, you can keep track of the amount by comparing new zero seating depth to the original.

There are a couple of other excellent uses for the dummy chamber tool. It's premature at this time to describe them, so I'll explain them a bit further along in the article.

To fireform the brass I used Speer 130 grain hollow point bullets #2005. I had quite a few in inventory and they were about the correct weight. Allen's rifle has performed well with Winchester 748 powder so that's what I chose for the fireforming task. Throughout all testing I used CCI BR-2 primers.

I started with 41.0 grains of 748 powder and increased powder charges in one half grain increments up to 45.0 grains. I wanted to discover if 748 could be maxed out in this cartridge, as well as determine the minimum charge for proper fireforming. Prior to starting the fireforming, I had thoroughly cleaned the barrel of all powder fouling buildup and copper fouling and completed the "one shot and clean" section of breaking in the barrel. I completed the break-in process on the barrel during the fireforming of the brass.

I zeroed the bullets to the lands and chronographed and shot for groups at the same time. Otherwise, fireforming can get pretty boring. Incidentally, in using 748, any powder charge form 42.0 grains upward, fireformed well the 130 HP Speer bullet, but I probably would recommend about 43.0 grains for the task.

Fireforming is something for which all handloaders understand the need. The problem is to know precisely when the job has been done correctly and completely. Now we're in the area of a second function for the dummy chamber tool; another measuring function.

Insert a fireformed piece of brass into the dummy chamber tool then measure the entire length of the combined brass and tool with a dial caliper. The longer measurements indicate the brass that has been fully fireformed to the chamber.

The brass that measures a few thousandths of an inch shorter will need to be fireformed again. What we're actually measuring, of course, is how far the shoulder has been pushed forward during the fireforming process. The dummy chamber tool is a good way for this measurement to be established.

The third use of the dummy chamber tool is almost exactly the opposite of the second. We've already talked about bolt lift and closure being an excellent method to determine when the shoulder of the brass needs to be bumped a bit shorter. When the need has been established, how do you know when you've adjusted the sizer die correctly to do the proper job? How can you be positive you're not setting the shoulder back too far? Do you need to fireform the brass again?

You've already determined the correct shoulder placement in the fireforming stage. You know the correct measurement. All you have to do is adjust the sizer die until it bumps the shoulder back to that measurement. You can take the guesswork out of the process. It will be more correct than the method used by the majority of shooters.

I tried some 150 grain and 155 grain bullets in a few different loads and they did perform well, however, by the very nature of their weight, they produced more felt recoil than I want for Hunter Rifle competition with a free recoiling rifle. I decided to abandon everything but the lighter bullet weights and concentrated between 125 grains and 135 grains, because the lighter 110 grain bullets didn't stabilize well.

I thought three powders would be fairly representative of performance level expectations in the 308 minus .140 case capacity. I chose Winchester 748, Accurate Arms 2460 and Hodgdon 322 (Muldex) as the slower, medium and faster burning rates. All testing was conducted using zero seating depth to the lands. All chronograph data was recorded over an Oehler Model 35P. The test results are shown in the following charts.

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BULLET	PRIMER	POWDER	CHARGE	VELOCITY	S.D.	100 YARD ACCURACY	COMMENTS
125 gr. Spitzer Sierra #2120	CCI BR-2	Win-748	42.5	2817	13	.288	64°
			43.0	2883	9	.228	70% humidity
			43.5	2894	23	.327	1-6 mph wind
			44.0	2938	21	.350	
			44.5	2966	21	.441	
			45.0	2989	23	.804	
125 gr. Spritzer Sierra #2120	CCI BR-2	AA-2460	42.0	2811	19	.546	Same as above
			42.5	2869	8	.817	
			43.0	2884	21	.907	
			43.5	2928	14	.420	
			44.0	2955	8	.769	
			44.5	3040	21	.569	
125 gr. Spitzer Sierra #2120	CCI BR-2	H-322	40.0	2878	17	.774	Same as above
			40.5	2906	18	.310	
			41.0	2937	13	.805	
			41.5	2958	2	.811	
			42.0	3016	14	.831	
			42.5	3030	7	.857	
125 gr. TNT Speer #1986	CCI BR-2	Win-748	42.5	2722	25	.714	71°
			43.0	2769	12	.422	74% humidity
			43.5	2815	32	.226	4-9 mph wind
			44.0	2844	18	.658	gusty
			44.5	2874	17	.360	
			45.0	2914	21	.341	
125 gr. TNT Speer #1986	CCI BR-2	AA-2460	42.0	2794	38	.987	Same as above
			42.5	2841	16	.840	
			43.0	2862	15	.610	
			43.5	2883	32	.610	
			44.0	2909	29	.397	
			44.5	2957	17	.394	

Continued on next page

LOW BUDGETING FOR A HUNTER RIFLE

Continued

BULLET	PRIMER	POWDER	CHARGE	VELOCITY	S.D.	100 YARD ACCURACY	COMMENTS
125 gr. TNT	CCI BR-2	H-322	40.0	2816	17	.270	Same as above
Speer			40.5	2868	4	.466	
#1986			41.0	2901	36	.448	
			41.5	2933	3	.562	
			42.0	2961	7	.429	
			42.5	2992	10	.483	
130 gr. HP	CCI BR-2	Win-748	42.5	2808	20	.566	73°
Speer			43.0	2827	7	.221	72% humidity
#2005			43.5	2850	13	.353	6-18 mph
			44.0	2876	22	.304	gusty winds
			44.5	2904	29	.539	
			45.0	2958	13	.466	
130 gr. HP	CCI BR-2	AA-2460	41.0	2771	23	1.432	Same as above
Speer			41.5	2804	12	.738	very gusty
#2005			42.0	2835	14	.943	winds
			42.5	2866	18	1.015	
			43.0	2897	32	.371	
			43.5	2937	18	.511	
130 gr. HP	CCI BR-2	H-322	40.0	2892	55	.320	Same as above
Speer			40.5	2923	13	.576	still very
#2005			41.0	2956	5	.872	gusty winds
			41.5	2980	8	.598	
			42.0	3016	16	.755	
135 gr. Single	CCI BR-2	Win-748	42.0	2783	14	.585	64°
Shot Pistol			42.5	2792	23	.647	77% humidity
Sierra			43.0	2846	12	.378	3-10 mph
#7350			43.5	2852	10	.337	slightly gusty
			44.0	2868	29	.356	winds
			44.5	2901	33	.410	
135 gr. Single	CCI BR-2	AA-2460	40.5	2745	28	.777	Same as above
Shot Pistol			41.0	2776	9	.605	
Sierra			41.5	2795	23	.342	
#7350			42.0	2819	15	.467	
			42.5	2833	18	.488	
			43.0	2884	5	.537	
135 gr. Single	CCI BR-2	H-322	38.5	2792	14	.710	Same as above
Shot Pistol			39.0	2816	11	.667	winds very
Sierra			39.5	2827	19	.417	gusty- picked
#7350			40.0	2866	11	.405	up to 5-15 mph
			40.5	2897	20	.486	
			41.0	2946	14	.622	
			41.5	2977	7	.721	

NOTE: Neither the author nor the publication makes any representation as to the safety of these loads in other rifles.

I found the starting load data on 300 Savage taken from the #12 Speer Loading Manual to be valid also for the 308 minus 140 cartridge. Other manuals may be equally good, but I didn't check them out. I didn't necessarily attempt to find the maximum powder charges, as usually the velocities were well within the areas I wanted for this rifle.

I'm always happy when I have new equipment to test, whether it's firearms, new shooting gear or handloading tools. I'm interested in the concept of what the new tool is trying to achieve, how well it succeeds and what had to be sacrificed to obtain the result.

Priming cartridge cases is a potentially dangerous area to a handloader. I've not

personally had any problem in this area, but I have seen a few photos and X-rays of unlucky hands when a primer was ignited while being seated.

Since the beginning of loading ammunition for this 308 minus 140, I've been using one of the relatively new RCBS hand priming tools. The manufacturer says it is the safest like tool a person can use. It probably is. It features a safety gate that automatically closes, isolating the primer being seated from the primers in the supply tray. The tray lid also has a gate that can be closed to stop the flow of primers to the feed ramp. It's handy when you have to put the tool down for a few moments.

The priming tool is a bit on the bulky side and a little awkward to use at first. It's also a little bit slow to change over from one shell holder size to another. You must partially disassemble the tool to do so. The interchangeable primer seating plungers need a bit of redesign work, in my opinion, as they can easily fall out and be lost.

The positive side about the tool is that the handloader can set aside any personal qualms about what would happen if a live primer should be ignited during the seating process. That's certainly not a bad trade off.

I spent nearly two months completing the testing and chronographing for this rifle. Obviously it didn't require a great deal of actual time to pull the trigger on fireforming and then shooting this many three-shot groups. The problem was wind. Lots of wind.

If you ever find yourself touring through the southeastern part of Washington State, please take in the beauty of our wonderful forests. Do note that a large portion of these glorious forests, especially those located in the flatlands and valleys, are composed of poplar trees. Also note that these forests have been planted in very straight rows. These forests are often seen on hilltops, around the houses, surrounding many of our fine vineyards, orchards and so forth. The local people have a descriptive name for these straight-line forests. We call them "wind breaks". However, they do not stop one damn bit of wind. I guarantee that to be a fact.

The chronograph charts really don't reflect the true accuracy potential the 308 minus 140 cartridge has to offer in this rifle, however, I was still able to obtain a bunch of valuable information with the preliminary testing. I didn't show the results in the charts, but I did do some work with 110 grain bullets. They were just too light to stabilize well in this one in fourteen twist rate barrel. I also found the performance of 150 grain and 155 grain bullets to be very good, but discarded the idea of using them in competition because of felt recoil. The 125 grain, 130 grain and 135 grain bullets seem to fill all the requirements for this rifle for its intended purpose. They shoot well, have relatively light recoil and turn up good velocity.

The three powders tested indicated they would cover the useable parameters of burning rates for this case capacity quite well. Not that they are the only useful powders, but I'd use caution going with powders much faster than H-322, and 748 is almost on the edge of being on the slow side. However, 748 showed a tendency to shoot groups that were a bit rounder. Especially with the lighter bullet weights. That impressed me.

For preliminary testing I use three-shot groups for accuracy and chronographing. What do three-shot groups prove? Absolutely nothing, but then neither do five-shot nor ten-shot groups. In truth, I'm not trying to prove that anything is "good" at this point. I'm trying to eliminate the component combinations that have the least amount of potential. When you notice a few areas that seem to have a bit of potential you can later concentrate with more detailed testing in those areas. In the meantime, you haven't worn out the barrel on stuff that wasn't of much value.

The chronograph shows that this reduced case capacity didn't have much effect on velocity. Three thousand feet per second was recorded with the 125 grain and 130 grain bullets, comparable to the advertised full length 308 Winchester cartridge with the same bullet weight and barrel length.

Further accuracy testing in a little better shooting conditions proved the 125 grain TNT Speer bullet with 44.5 grains of 748 powder was a reliable combination. I tried a couple Hunter Rifle targets one afternoon with results of 49-2X and 50-4X. Not earth shaking, but pretty promising. Now I need to order a batch of custom bullets and to learn how to read the wind flags better.

There is one area in which my rifle can never compare with Allen's Hunter Rifle. He takes pure delight in owning and shooting a competition rifle that's a real head turner. It has a very unusual stock. It appears to have been made up from a cedar fence post reject. The outside dimensions were quite possibly shaped by a beaver with very dull teeth. I once heard it said that Allen's Hunter Rifle was so ugly that if he had an ugly brother, he'd refuse to carry it for him.

I knew full well I could never top his act so I didn't even try. As soon as it was certain the bedding job was a good one, I prepared the stock for a self inflicted paint job. (The definition for self inflicted means he who sprays paint into the wind ends up with hands and arms the same color as the stock).

Seven or eight years ago I ran across a liquidation sale of small spray cans of automotive touch up lacquer, in a variety of colors. In caselots they only cost thirty cents each. I took home a bunch of them. They've served me well on a lot of small projects, however, they are starting to show their age. The paint doesn't spread as well as it used to, especially the metallic colors. The advantage of lacquer is, though, that I can patch up all my mistakes. Overspray is a problem with aerosol spray paint, but rubbing compound, judiciously applied, gave me a finished product that's acceptable. Not professional looking, mind you, but not bad either.

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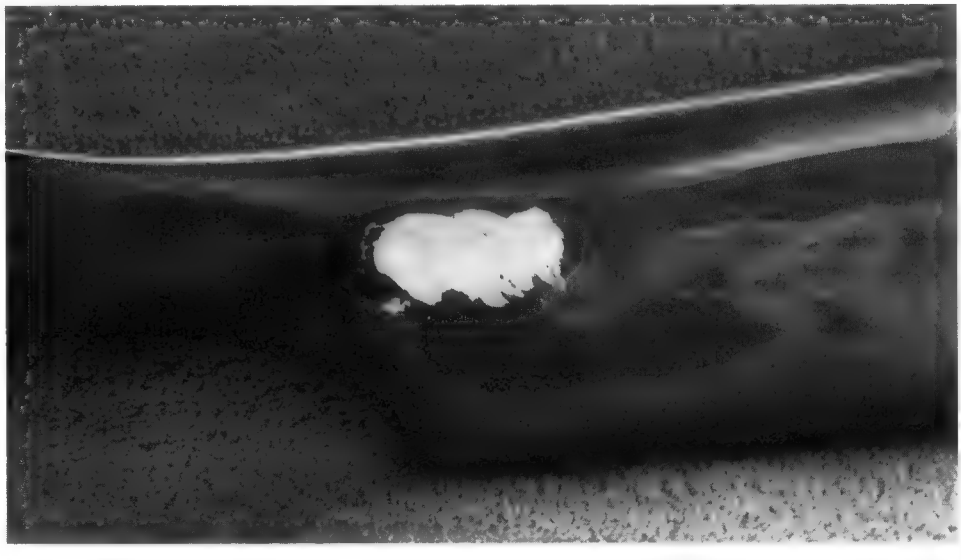


A small run was noticed in the paint. Under the run there was a small blister. Under the blister a small pin hole was found. The pin hole was the top of an air bubble. The air bubble got called a lot of bad names.

LOW BUDGETING FOR A HUNTER RIFLE

Continued

Just prior to completing this article, I received a set of new Burris scope rings they have named Pos-Align System. It looks to be of value.

It's not unusual, when mounting a scope to a firearm, to find screw holes out of alignment or off center. The front and rear surfaces of the receiver are not always of equal height either. It's really frustrating when sighting in a firearm to run out of scope adjustment before you can get the bullets to hit where you want them. Some mount and ring sets can be adjusted for windage correction, but if elevation is the problem, you're usually forced to resort to shimming; a less than desirable solution.

The Burris Pos-Align System offers a different solution. It's comprised of steel outer rings with synthetic inserts that swivel inside the outer rings. There are several insert sizes that offer various degrees of offset. The offset combinations compensate for a great deal of scope misalignment. The manufacturer says that up to forty inches (a direct quote) of bullet impact change can be obtained at 100 yards with this new System. It also allows for perfect scope/bore alignment. There is no stress placed on the scope tube and the scope will not slip or mar in the rings.

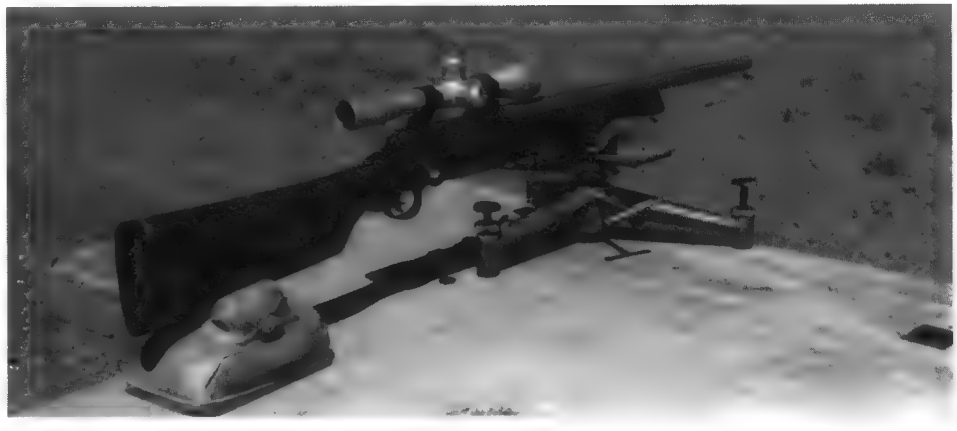
They are a bit on the heavy side, weighing in at 3 1/2 oz., however, the retail price of $49.00 is pretty reasonable. I can make the maximum weight restriction with these rings on my new Hunter Rifle, but with only about one ounce to spare.

The 308 minus 140 Hunter Rifle is reality now. It suits my purpose. I believe I achieved the goal I set out to do; a budget rifle that is competitive.

The NBRSA allows custom actions in Hunter Rifle class which would be a great place to start if you were building a top of the line competition rifle. Adding the best equipment available and the services of a well known professional gunsmith could easily add up to a couple thousand dollars, or so, including the scope. My total outlay for my low budget Hunter Rifle is well below a third of this price. I accomplished it by making deals, taking advantage of equipment bargains, etc. I'm not proud. I just want to shoot competition.

In the future if you see a well made Hunter Rifle on the firing line with a nifty $1.40 paint job, and the shooter can't read his wind flags worth a dang, stop by and say hello. It will probably be me.

The winter/spring project is completed.



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BOB JOURDAN ON THE REMINGTON 788

Dear Bob,

I've read - with great interest - your articles in ***PS***, and recall that you have written often on "Improved" cartridges. Certain that you know more than I regarding such things, I'd like to put a couple questions to you, or elicit your thoughts on the following:

I have a Remington 788 that I am considering rebarreling. I recall reading somewhere that this action, like most rearlug actions, tends to stretch brass. I have found this to be the case. So, my questions are:

1) Is the 788 (I'd rather have a 700, but...) a decent choice for a new match barrel for a varmint/antelope rifle?

2) If it is, can I hope to solve - at least partially - the case stretching problem by chambering to 6mm Ackley Improved? (It's currently a 6mm.) Ackley's writings imply that the Improved case delivered less bolt thrust than the factory case, at least in some instances.

I've enclosed a SASE for your convenience, and thank you in advance for your thoughts and advice.

Clean kills or clean misses,

California subscriber

Dear Tom,

Nice to hear from you concerning your Remington M788. As you probably know, that action is often used to build a Hunter category benchrest rifle around, and it has an excellent reputation for accuracy. It first came out back in 1967 and lasted until about 1984 when it was discontinued. Throughout its history, it was considered an excellent rifle for the money, being one of the lowest priced rifles offered in the dozens of calibers it eventually was manufactured in. It was even offered in a left-hand model, now rather highly sought after by collectors and many left-hand shooters. The receiver was considerably stronger than that of the Remington M700, with thicker walls and smaller cut-outs for the magazine and ejector port. The trigger, however, was never in the same league with that of the M700. It is not adjustable but can be replaced with a top quality aftermarket, light pull trigger from Canjar, an advertiser in ***PS*** magazine.

Your question about the M788 being made into a varmint/antelope rifle by installing a first class barrel is right on. In my own shop, I have totally quit installing barrels other than stainless, benchrest grade, because they do not cost a great deal more than run-of-the-mill barrels, and they always assure top accuracy. Any accuracy problem with the original rifles could almost always be traced to the poor barrel quality or the poor fitting, and usually both. Have the action trued and install a benchrest grade barrel, and perhaps a Canjar trigger, and you will have a top-notch varminter or antelope rifle.

The case stretching problem is most often the result of chambering that has too much tolerance, thus providing just a little too much headspace. This is the normal method of chambering in factories. Add this to an action that is out of true, and all kind of things go wrong. This is mostly corrected by truing the action and chambering to a very close tolerances, near zero.

The Ackley chambers do contain pressure better than any of the regular factory models. The straight side walls allow the cases to expand and grip the chamber wall early during ignition, thus holding the cartridge head in place and reducing the backthrust on the bolt. A cartridge with a standard tapered case will be trying to back out of the chamber from the very beginning of ignition. You can overload an Ackley cartridge, fire it and examine the primer and head closely, and you will find the head not showing bolt face marks and the primer still round at the edges. Extraction is always improved. As you may know, the Ackley Improved chamber is cut .0074" shorter than the same factory chamber so as to be sure that factory cartridges are somewhat jammed in the chamber to assure proper headspace on those factory cases than vary in length. That is why the standard "GO" headspace gauge is used as a "NO GO" gauge for the Ackley. Many gun shops do not know this...! The standard thinking is, if the chamber can be used for the standard cartridge, then the standard "GO" gauge must be correct. That is dead wrong, and you, the owner, have to be aware of this if you want your new Ackley chamber to be properly cut. I rework about a dozen Ackley chambers every year because the original shop headspaced on the standard gauges.

Case stretching just about does not exist with Ackley chambers. The 40 degree shoulder holds all the brass back. Actually, when you fireform a standard case into an Ackley, the overall length will be about .015" shorter, and it will never "grow" to the full length of the standard case.

Tom, I think you will be very satisfied with that M788 rebarreled with a benchrest quality barrel in 6mm Ackley. I do not know of a better long range varmint cartridge, and it is a very deadly antelope, deer and elk cartridge. I have a rancher friend in Utah who has never owned but one rifle, an old-timer called the .244 Remington (now known as the 6mm Remington). He had one of the best Wyoming moose heads mounted in his home that you are likely to ever see, and it only required one shot from that cartridge with the 90 grain bullet. He also has a nice big horn sheep and a large, 18 to 20 point mule deer, plus a few common elk and some other sorts of big game, all taken with that cartridge. So, if you improve it to that of the Ackley version, gaining several hundred feet per second with each bullet weight, I don't think you really need any other caliber!

If you do go ahead with the rifle, I'd be interested in knowing how it all comes out.

Keep shooting.

Bob Jourdan

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THE TWO POINT SLING REPOSITIONED

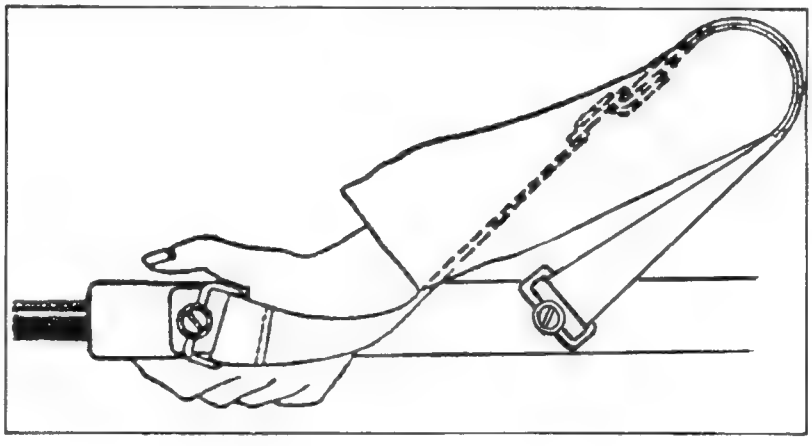
by

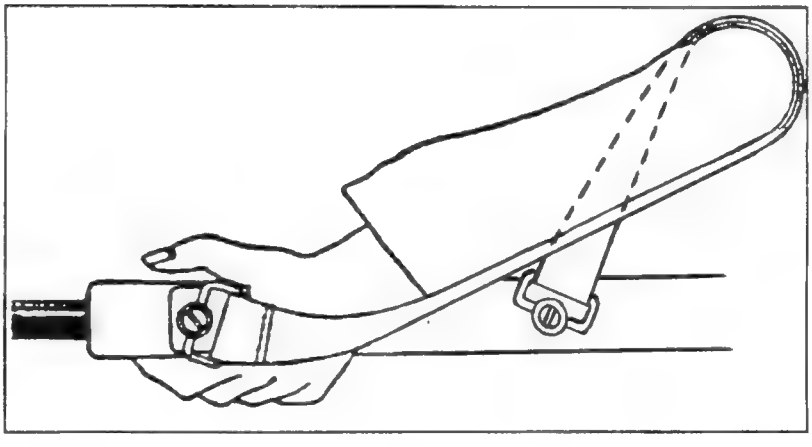
Mike Baillie-Hamilton

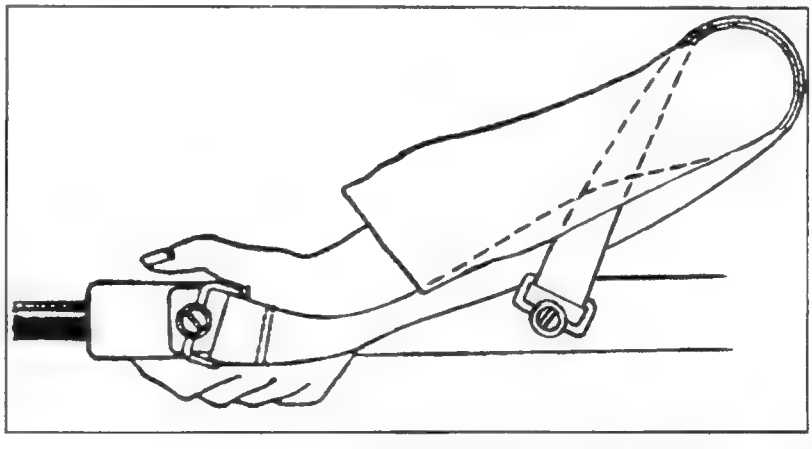
I was interested to read Lester Karas article in the January 1996 edition of ***Precision Shooting*** on the merits of the single and two point slings. The arrangement of the two point sling which he illustrates is the simplest version and is the arrangement which I was taught as a schoolboy. May I suggest that there are in fact two further variants on the general theme. In the ***1995 Precision Shooting Annual***, Frank Randall illustrates a two point sling with the sling crossed over on itself ready to form one of the alternatives. It is not clear from my copy of the annual whether he has the rear section on the top of the front or vice versa. In either case the firing position is adopted in much the same way as for the simple two point sling. For right handers this is done by sliding the left hand and elbow through the sling and then looping the left hand under and then over the front section. The above words, although carefully chosen, have probably left most readers more confused than when I started so I have amended Lester Karas diagram to show all three variants as viewed from below.

My strong preference is for the version with the front section on top. To help adopt it I would suggest the following routine. Before lying down, hold the rifle in the right hand at the front of the receiver. Lay the front end of the sling along the underside of the stock passing to the left of the trigger and hold it there with your trigger finger (photo 1). Lay the rear end of the sling along the underside of this and hold it with the rest of your right fingers (photo 2). This process maximizes the size of the loop which you now put your left hand and elbow through (photo 3). Now loop the left hand under and back over the front portion (photo 4) and lie down (photo 5). Contrary to what Karas says, you can fix the sling over a hook on the upper arm. Photo 6 shows my homemade sling attachment in more detail.

The obvious question you will ask me is why explain all this rigmarole when I consider the single point sling so simple and effective that I use it almost universally? I believe the single point sling is generally better but the two point sling does have one major advantage. It is much more stable laterally. In strong buffeting winds it will give a much steadier hold and save you from those infuriating and clearly called sideways shots. Better than that it will hold your group together so that you don't correct on apparent wind errors which were actually buffeting errors. I use a single point sling for all small-bore and most full-bore shooting but if the wind becomes strong (16mph or more) and the firing point is exposed I will switch to my two point sling. Curiously I do not appear to suffer any shift of zero. When I am not shooting with it, I use it as a carrying strap on my kit box so it is always to hand.







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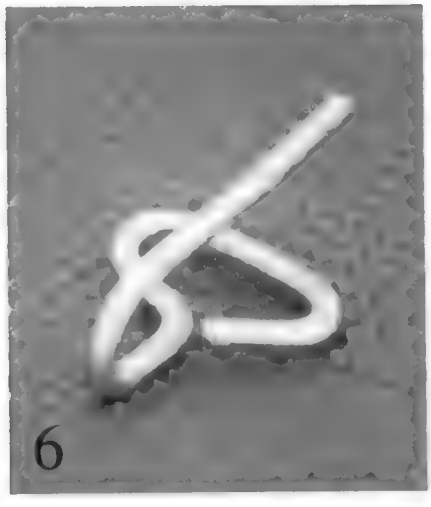
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CONCEPT RIFLE

by

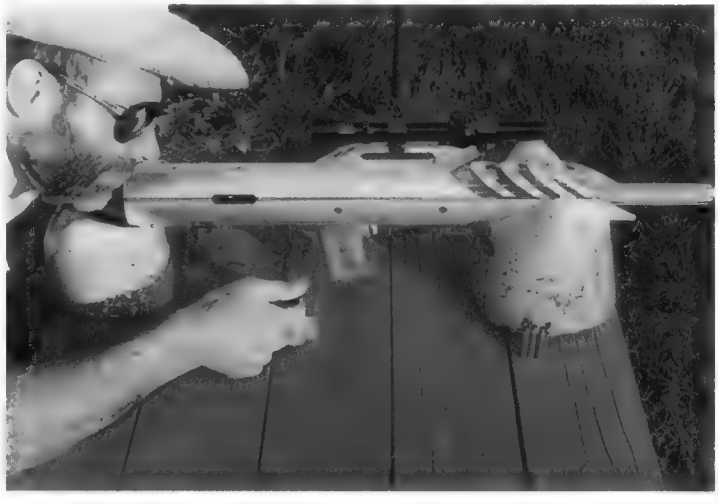
Louis T. Carabillo, Jr.

This long-time shooter-experimenter has to pique himself with a new, challenging project, from time to time, to maintain a healthy, keen interest in the sport. One such instance of note was prompted by the need for a rifle some years ago meeting rather special requirements. I believe the overall experience to be share-worthy, among fellow shooters.

Though I reside in the tranquil hills of Colorado, my heart is in the High-Country of Colorado, and I've spent much time there, trekking the vast realm of ice, rock and sky. High-Country Varminting, as I know it, involves hiking into (usually, "up to") some of the roughest, most breathtaking country (literally), in these "lower 48"— up to 14,000+ feet elevation. The typical "Heavy Varmint Rifle" configuration, well suited to Eastern hinterlands, is just too long and cumbersome for this special task — as early trials have proven. Clearly, what was needed is a short, easy to carry rifle with high-level accuracy capability: 1/2 M.O.A., or better.

The project turned out to be heavily mined with challenges — generously rewarded with new heights of excitement. What finally emerged was the handy Bull-pup design shown here. Additionally, it served as the test "vehicle" for developing several concepts previously locked in drawing-board-status limbo. Balancing these to work in harmony was the key. The project is an ongoing one, and to date several features have been incorporated into the overall design. First, the rifle was intended to be a short one, and short it certainly is, with an overall length of 28 3/4". The barrel, chambered for the .223 Remington cartridge is 21" long, one inch in diameter, and has the front 12 1/2" fluted. The gun's ignition is set in motion by an electronically activated sear; the battery - powered solenoid has one primary trigger switch on the pistol grip (9 volt battery located inside), and there is a secondary remote wire - connected switch plugged into a jack behind the pistol grip for utilization as might be needed. The stock is concave shaped, with a shoulder fitting plastic butt, with a primitive ring recoil absorber. The carrying handle is located at the center of gravity, and also serves as an integral scope base. A sling swivel stud is mounted just behind the carrying handle. Wide spaced integral rails are on the bottom portion of the forward housing, for increased stability over varied front rests. The action for the rifle is a manually operated (only) AR 15 abbreviated upper (via serrated push-pull knob on the rear of the carrier), with the author's special 1/2" deep lower attached. A two point bedding system, the heart of the overall design, locates and secures the complete barrel - action assembly at approximately the mid point via two sets of radically mounted bolts.

It is of possible interest that I have been working with an interchangeable, 25" long, similar 1" diameter .375 - 308 Winchester chambered barrel, with the necessary open - faced bolt. Using shop - made saboted loads (4000 + fps with 70



Author using secondary remote firing switch.

Right front quarter view.

Right rear quarter view, w/custom-fitted carrying case.

Author demonstrating ease of portability in the field.

grain .243 bullets was achieved). However this phase of development has been put on hold pending the availability of high quality .375 diameter sabots. Although the rifle can be magazine - fed (AR15 type), it is usually hand - fed single rounds, through the large magazine port. Finally the high degree of handiness of the rifle, combined with good balance, belies the 10 pound weight of the overall package.

The battery - powered solenoid has been found to function properly, for some hours, even when subjected to sub-freezing temperatures. The 21", .223 Remington chambered barrel is a "production grade" barrel, and not "match grade". Be that as it may, the rifle still regularly shoots 3 shot groups of 3/8" size at 100 yards with a Tasco 4-16x scope and Remington 55 grain Power Lokt bullets, using the primary trigger switch.

The success of the rifle to this point in time encourages me to try for further development.

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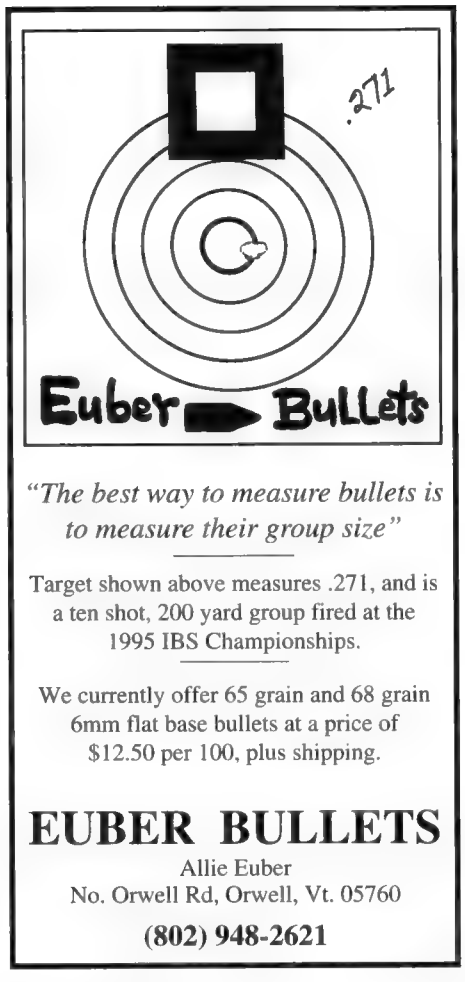

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ACCURACY EXPECTATIONS
(FOR MATH HATERS)

by
Jack Rush

As I told Dave Brennan, *True Benchrest Accuracy* by Bob Jourdan was one of the best articles on accuracy that I have ever read. It should be required reading for every shooter in the pursuit of accuracy. If it does nothing else, it is therapeutic in the sense that it reduces anxiety. One no longer has to worry so much about why your own results do not seem to compare with the performances of the very best. It allows speculation that perhaps, on the average, your results may be about as good as the best.

Bob's article deals with averages. He uses "mean" group sizes to show that top competitors averages are no where near their best winning group sizes-the ones we think we should be striving for. He rightly points out that there are no quarter inch rifles, in terms of long term group averages.

In an earlier article on statistics I pointed out that there are three common measures of average: mean, median and mode. These should all be the same on a perfectly distributed set of statistics – whether they be velocities, test scores or whatever.

There are some non perfect distribution measurements in the real world, and imperfect distributions produce curves that are "skewed" rather than bell shaped. Compiling group sizes results in one of those skewed distributions. Because of this skewed distribution, using the mean as the average gives a slightly pessimistic view of the accuracy you are getting. I am going to suggest that you also use the mode (most common group size) to assess performance; and how to use simple statistics to improve performance.

Here is why you get a skewed distribution shooting groups: If you shot a hundred or more groups you would find that the rifle shoots most of the time in a very narrow range. Let's say you can usually expect it to shoot about .4 of an inch, give or take a tenth of an inch. If you are particularly lucky you shoot an occasional group of .2. Now if the results of compiling the sizes of 100 groups were to have what is commonly referred to as a "normal" or bell shaped distribution, your worst occasional groups would be about .6 of an inch, with about equal frequency to your occasional .2 groups. Such will not be the case. The reason for that is simple: There are a lot of things that can go wrong, including bad hold, wind, imperfect bullet, bad cleaning, hiccups and sneezes that can greatly worsen a group. There are very limited circumstances that would cause you to shoot a much better group than your average. Also, your best group cannot be better

Continued on next page

ACCURACY EXPECTATIONS

Continued

than Zero, and the statistical chances of ever shooting a zero are very slim. There is no limit to how bad a group can be, and bad groups obviously occur with greater frequency than good groups for all the above reasons.

Though I understand statistics quite well, I have a deep dislike for the linear thinking of mathematics, and understand most people's aversion to it. Therefore I will attempt to explain what this means in terms of evaluation of your rifles performance without use of formulas or formal statistics.

If you recorded all one hundred of the group sizes on a piece of graph paper, with each vertical line representing increments of, say .01 of an inch, and each horizontal line depicting one shot fired, and drew a line through the top X on each vertical line, you would get a curved line on the paper that would show most of the shots piled up at around .4 give or take about a tenth of an inch.(assuming this is about what your rifle seems to shoot.) The line will look something like the silhouette of a hill. It will have a steep short slope and tail to the left, the direction of the smallest groups. It will have a long slope and tail to the right, the direction of the worst groups. A skewed distribution of this type is not a "normal" distribution. The three kinds of averages are "pulled apart". The extreme group sizes at the right or "worst" end affect the mean score the most. The median is the middle score, that is the score that is 50 from the top and 50 from the bottom. If you used this median score as the measure of your average group size it would tell your that your rifle shoots better than this half the time.

The "mean" score, which is what Bob used in his article, and is the figure most of us think of as THE average, may be pulled even farther from the center by some really bad groups, and give an even darker estimate of the rifle's grouping ability.

It seemed to me that Mr. Jourdan's article was about EXPECTATIONS and dealt with the reality of group shooting. My point is that if you base your expectation on the mean average group your rifle shoots, you will USUALLY shoot better than that because your statistics are based on a skewed distribution.

A somewhat useful addition to mean average is based on standard deviation, and that can be determined in several ways. Some ballistic programs will compute such statistical measures of data. Lots of hand calculators will do it for you simply by entering the group sizes and pushing a couple of buttons. You can do it yourself by following the instructions in some loading manuals. One such is the 46th edition of the Lyman, on page 141. What the standard deviation tells you, is what the chances are of shooting a group size within one standard deviation of the mean average. In a normal distribution, you will shoot groups within one standard deviation of the mean 68% of the time and within two standard deviations of the mean 95% of the time. There are also levels of confidence that this figure is accurate based on sample size (# of groups) and complicated statistical formulas. In skewed distributions, standard methods of computing standard deviation will lie to you. Certain adjustments are necessary to give a true measure of accuracy and variability. Therefore, even this common measurement of distribution is not to be trusted in predicting rifle performance in the case of group size. (It works great for velocity, which is a normal distribution)

For those of us less inclined to fool around with mathematical precision there is another way of looking at this question of expectation or, as statisticians call it, variability and probability.

It goes like this: Record all your groups. When you have a large number collected, say 25 or more, write them down in a column in order of size. When you see a cluster of groups that are all very nearly the same size, give or take a tenth of an inch or less, you have found something like the "mode" or most common group size. Bracket this. The isolated mode or actual mode is not very useful. A group of numbers clustered together will represent the true mode. This is the range of group size you most commonly shoot.

Then to determine how likely you are to be able to shoot a group of acceptable size you can proceed as follows: Draw a line at the point the groups become unacceptably large in your judgement. Perhaps you will draw this line at what you see as the big edge of the mode. Count the groups that are better and worse than that figure. Now you can easily figure what your chances are of shooting a group that is acceptable to YOU.

You thus can see two things, what your rifle commonly shoots, and what the chances are of acceptable groups.

I have noticed that really good rifles have a more skewed distribution than a poor rifle. That is to say, that the mean average of groups from a poor rifle tend to me nearer the mode. Poor rifles shoot better and worse groups with more equal frequency. Really accurate rifles tend to shoot more bad groups than really good groups, or you can say that the difference of a bad group from the mode is greater than the difference of a good group from the mode in these very accurate rifles. Thus greater skewing. The reasons for this are fairly obvious when one considers the causes of good and bad groups. Also, poor rifles have more "room for improvement". I mention this only for your edification, as it has little to do with the point of this article.

As you shoot groups, you need to make notes. NEVER THROW OUT A GROUP FOR ANY REASON. Bad groups give you the best opportunity to analyze your mistakes. Draw from your list of excuses. Note after the poorer groups, what you think were contributing factors, and work toward eliminating those factors. (powder lot, bullet lot, wind judgement, hiccups, etc.) This will help to bring your mean average closer to the mode and your expected level of performance will gradually improve. Keep in mind that factors causing bad groups are more numerous than factors causing good groups, and that the more you shoot, the more likely it is that your mean average will deteriorate do to wild fliers - unless you find ways to reduce the frequency of fliers. Hopefully the mode will stay in about the same range or improve.

None of this is intended to minimize the importance of keeping track of your mean average, it is an alternative way of looking at "average". Rather than expecting average, you learn to expect the mode or more common group size your rifle shoots and it gives you a framework for thinking about improvement. When you see both your mean average and your mode, this difference is encouraging and provides motivation to improve.

When you tell me that you have a quarter inch rifle, wink with the right eye if you are referring to mode, the left if you are referring to the best group you ever shot. If you are referring to mean average, give it to me on a sworn witnessed affidavit, and throw me a price.

GETTING STARTED BUILDING YOUR OWN BOLT-ACTION RIFLES

by

James B. Higley

Why would anyone want to make an action when those offered by commercial manufacturers are nicely designed, well made and reasonably priced? The desire to build rifles goes deeper than the satisfaction of creating useful items from raw materials; it results from a passion and fascination with precision mechanical components. To describe this passion in general terms, we'll start by following the path from shooter to apprentice gunsmith to rifle maker. Then, let's continue with the legal issues of making rifles followed by a few tooling tips and two home-made rifle examples.

The Seed Is Planted

Sometimes, seemingly unrelated activities, when combined, complement each other in unexpected ways. Rifle shooting and precision tools appear to have little in common. Yet, a nicely made handgun, rifle, or shotgun placed next to a micrometer, lathe, or milling machine reveals many similarities, which may be explained in the following way. Both firearms and tools have a complex set of precision parts that fit and function as a group; without precision neither the tools nor the firearms function. This close tie between tools and guns leads technically minded shooters, especially those interested in precision rifle shooting, to gunsmithing.

The transition from shooter to gunsmith normally begins with a predictable sequence: mounting scopes, glass bedding, trigger tuning and action work. After learning these initial tasks, a new gunsmith needs more challenge which comes from fitting barrels. That requires a lathe, opening a whole new world of possibilities. A new lathe owner can familiarize himself with basic lathe operations by reading the January and May, 1996 issues of ***Precision Shooting*** or a basic machining book. I'd advise you to purchase *The Amateur's Lathe* by L. H. Sparey from Brownell's in Montezuma, Iowa.

After learning how to thread and chamber barrels in a lathe, a gunsmith finds fitting them on hunting rifles an easy task, but he must also true the receiver for maximum accuracy. Even high priced commercial rifles lack true alignment. That means recutting the locking lug seats, the receiver face, and the internal threads, so the barrel, bolt and receiver all line up. Re-cutting the internal threads on a receiver demands great patience, and one mistake trashes a $300 receiver. Our gunsmith passes a milestone when he can fit a barrel to benchrest standards.

Fitting barrels satisfies many gunsmiths, and they stop with the lathe, but others wonder about a milling machine. The milling machine makes stockwork much easier. The cover of the August, 1994 issue shows stockwork being done that way. Nothing beats a mill for drilling and tapping scope/sight holes, adding three position safeties, and so on.

At this point our gunsmith has the necessary tools and with some practice on them can get his rifle shooting straight. He has seen many different actions, taken them apart for study, and read the few books available on action design, after which he concludes that commercial actions have some faults. The ubiquitous Remington 700, a fine action, has cost cutting compromises. For some gunsmiths this is unacceptable, and they decide to make a receiver, possibly even the whole action.

Legal Issues

Making your own receiver requires some understanding of the laws related to firearms manufacturing. These appear in publication ATF P 5300.4, titled FEDERAL FIREARMS REGULATIONS REFERENCE GUIDE. You may obtain a copy free of charge by calling the Bureau of Alchol, Tobacco, and Firearms (ATF) Distribution Center in Virginia at 703-455-7801. This 114 page guide contains the United States Code and the Code of Federal Regulations pertinent to firearms.

Continued on next page

PHOTO #1 A completed .22 target rifle using a Remington 40X rimfire bolt. The rifle has a Krieger barrel, Jewell Trigger, McMillan Hunter BR stock, and Leupold 36x scope.

GETTING STARTED BUILDING YOUR OWN BOLT-ACTION RIFLES

Continued

A question most gunsmiths have and its answer are quoted from page 104:

> (A7) Does the GCA prohibit anyone from making a handgun, shotgun, or rifle? With certain exceptions a firearm may be made by a nonlicensee provided it is not for sale and the maker is not prohibited from possessing firearms. However, a person is prohibited from making a semiautomatic assault weapon or assembling a nonsporting semiautomatic rifle or nonsporting shotgun from imported parts. In addition, the making of an NFA firearm requires a tax payment and approval by ATF. An application to make a machinegun will not be approved unless documentation is submitted showing that the firearm is being made for a Federal or State agency.

The above quote tells us we can make bolt action rifles for personal use but not for sale. The ATF also strongly urges private makers to mark the receiver in a unique fashion so it may be identified in case the rifle gets stolen. Specific questions about building homemade firearms should be directed to:

BATF Firearms Technology Branch
Room 6450 650 Massachusetts Ave NW
Washington, D.C. 20226
202-927-7910

Despite all the bad press the ATF has had lately, I have found the Firearms Technology Branch helpful and courteous. They answered my telephone calls thoroughly and responded to my written requests in a reasonable time. Even though this branch of the ATF knows about this obscure law, other agents may not. The police certainly will not. So, you should keep a copy of publication 5300.4 handy when transporting home-made firearms. If you are interested in selling your actions, contact your local ATF representative for information on how to apply for a manufacturer's license.

Special Tools

Manufacturing a rifle receiver requires many standard machining techniques and a few special ones. The standard techniques can be learned in a college machining course and by routine gunsmithing. Three unique action building tasks you may need help with are cutting locking lug slots, cutting cams needed to close the bolt, and drilling the bolt hole. The first two topics have been covered in previous issues of ***Precision Shooting***. You may want to look back to *Building A Rimfire Action* in the January, 1993 issue; *The Mechanics of Internal Slotting* in the January, 1995 issue, and *The Homemade Action* in the December, 1995 issue. Drilling the deep hole all the way through the receiver can be done on a lathe with patience and sharp drills. Alternately, you might want to contact a firm that specializes in gun drilling or deep hole drilling. Those firms will drill this deep hole straight and smooth for a reasonable fee.

Examples

For some early action building projects, I decided to use existing bolts. The first action presented here is built around a Remington 40x rimfire bolt and the second an old Remington 722 centerfire bolt. Both receivers look like their Remington counterparts with some improvements. Since the rimfire action differs most from Remington's, I'll list the improvements:

- receiver diameter, 1.400" in diameter versus Remingtons 1.350"
- loading port, sized for a .22 rimfire cartridge
- recoil lug, bolted to the receiver bottom
- bolt stop, used one from a Ruger 77 (see photo 7)
- locking lug slots, they only go to the locking recess instead of all the way through (see photo 4)
- receiver bridge, left full diameter
- outside finish, ground on a cylindrical grinder so the receiver is straight which aides bedding

The centerfire action looks like a centerfire 40X action except for the smaller loading port, full height bridge, and Ruger bolt stop. Photos 5, 6, and 7 show the completed centerfire action.

A word on bolt stops is in order. In my opinion, Ruger makes the best bolt stop. It is easy to fit, costs only about $10, and has a spring cushion effect which avoids damage to the bolt. You can purchase one directly from Ruger by calling their parts department at 603-863-3300. The bolt stop has several parts to it, so be sure to ask for a complete assembly.

Where Do We Go From Here?

We completed the advance from shoot-

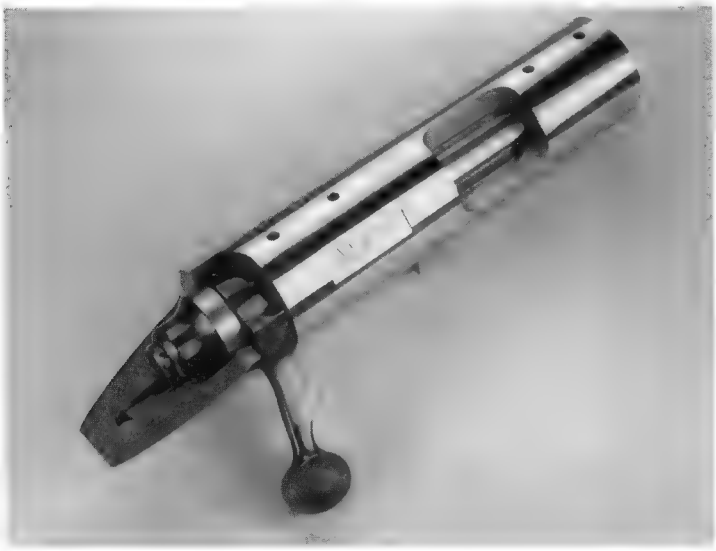

PHOTO #2 Top view of the rimfire receiver showing full height bridge.

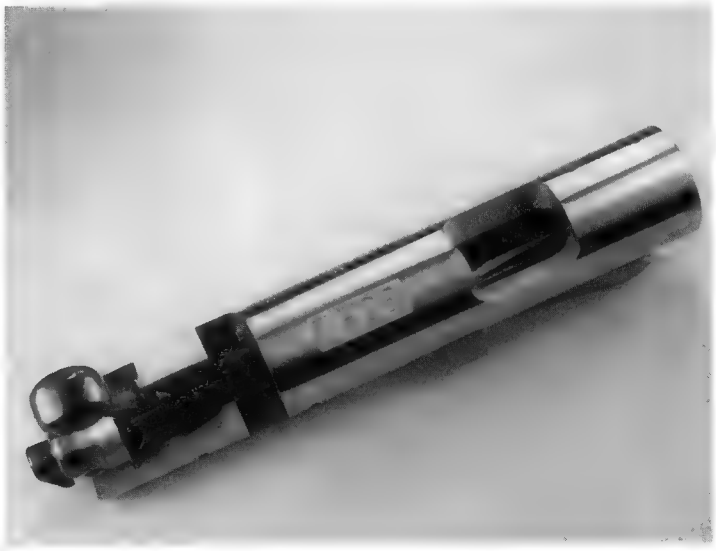

PHOTO #3 Right side view showing small loading port sized for a rimfire cartridge.

er to gunsmith to rifle maker. Perhaps you now understand how an interest in firearms builds into an interest in tools and their combination generates a desire to build rifles. After building a receiver around an existing bolt, all that remains is to design and build a complete action, including the bolt. This step requires considerably more work as even the simplest bolt has several complicated parts. But, judging from the number of custom actions available today, many people have taken this last step and gone into business selling actions. Even if you don't go into selling actions for a living, please send pictures of your homemade receivers, actions, and completed rifles to ***Precision Shooting*** so we all can learn from your experiences.

James B. Higley
Purdue University Calumet
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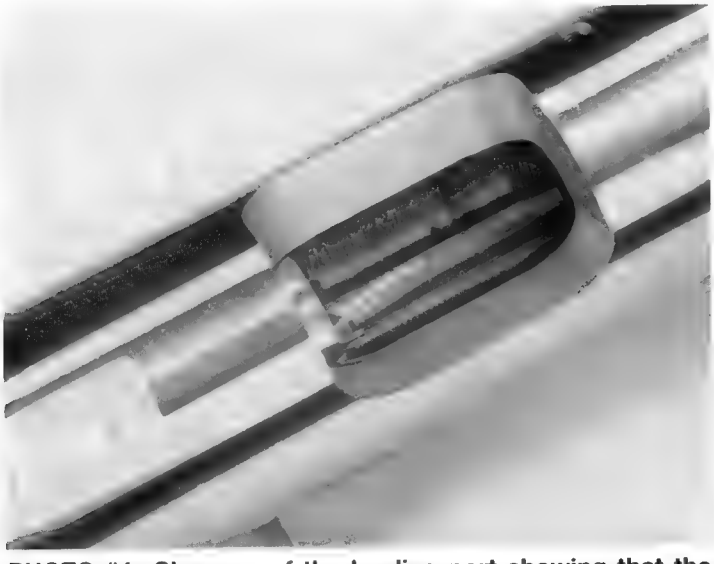

PHOTO #4 Close up of the loading port showing that the locking lug slots do not go all the way through.

PHOTO #5 Right side view of the centerfire action with a Remington 722 bolt and Remington trigger.

PHOTO #6 Centerfire action with the bolt open.

PHOTO #7 Left side view of the centerfire action showing the Ruger bolt stop.

SCOPE TILT OR CANT ERRORS — MUCH ADO ABOUT NOTHING

© 1996

by

Art Pejsa

Another type of long range shooting 'problem' has gained a lot of notoriety of late. There are now gadgets on the market with spirit levels and the like to help solve it. This problem originally had to do with the scope being unknowingly tilted or canted during the sighting-in process.

With some shooters this problem now includes shooting with the rifle tilted, after it has been properly sighted-in. I have heard of and read about vertical 'errors' of two or three inches at 200 yards and as much as eight or nine inches at 300 yards supposedly caused by scope or rifle cant, which is utter nonesense. As in Shakespeare's famous comedy, this is truly Much Ado About Nothing.

This problem is now also interpreted by some to include the unwanted lateral movement of the impact point with changes of the vertical sight line adjustment knob. This of course has more to do with the internal axis about which the scope lens actually rotates during an adjustment rather than the external tilting of the scope.

The main reason, I believe, that the wild claims of huge vertical errors due to 'canting' have gone unchallenged is because this whole sighting-in phenomenon is quite difficult to sort out properly and can be confusing. I believe my analysis below is simple enough to be followed by most any serious long range precision shooter.

Errors Due To Scope Cant While Sighting-In

For simplicity, we will proceed in several simple steps. First, Let the rifle be mounted and fired with its bore line precisely horizontal. To be specific, I have selected a typical bullet with muzzle velocity Vm= 3100 fps and ballistic coefficient BC=.451, which happens to result in a trajectory with a vertical drop of precisely 8.0"(inches) at 200 yd, 19.0" at 300 yd and 35.75" at 400 yd, as shown.

Let our sight line begin 1.5" above the bore (typical) and be tipped downward at an angle which descends 9.5" in 200 yd so as to be 8.0" low and intersect the trajectory at 200 yd and thus be "zeroed" at 200 yd. This sight line, descending at 4.75" per 100 yd, thus is: 8.00+4.75 or 12.75" low at 300 yd and 8+9.5 or 17.5" low at 400 yd. Hence, the flight path is: 19.0-12.75 or 6.25" below the sight line at 300 yd and 35.75-17.5 or 18.25" below at 400 yd; figure 1.

To see clearly what happens when the scope and sight line are tilted or canted, imagine that the above bore line and sight line are imbedded in a cylinder which is ROTATED 5 degrees ABOUT THE BORE LINE AXIS. 5 degrees is a lot and should be easily detectable. Figure 2 shows a back view of the vertical, the tilted sight line and the bore line axis.

The point of this approach is that the bore line has not been moved by the rotation, hence the trajectory remains fixed. However, the sight line which is 8.0" low at 200 yd has thus apparently moved horizontally 8.0"x sin(5) or 0.70" and 8.0"x [1-cos(5)] or 0.030" vertically at 200 yds, as shown in figure 2.

At 300 yd, the sight line is 12.75" below the bore line and thus moves laterally 12.75/8 times as much as at 200 yd or 1.116" (and 0.048" vertically). At 400 yd, the sight line is 17.5" low and thus moves 17.5/8 x 0.70 or 1.53" laterally (and 0.066" vertically),due to 5 degrees of scope cant.

To again "zero" the rifle at 200 yd, the shooter must thus adjust the sight line 0.70" laterally which requires 1/3 moa (minute of angle). The 0.030" vertical 'error' is utterly undetectable. At twice 200 or 400 yd, this 1/3 moa adjustment moves the sight picture twice 0.70" or 1.40" laterally and moves it 3/2 x 0.70" or 1.05" at 300 yd.

The net error due to scope cant is thus zero at 200 yd, the "zero" range. At 300 yd, the resulting lateral error is the difference between the result of the tilt and the adjustment or: 1.116"-1.05"= .066". Similarly, the lateral error is 1.53-1.40= 0.13" (or about 1/8 inch) at 400 yd! For a cant angle of 5 degrees the vertical errors are 20 times smaller than the above lateral errors and are indeed nothing.

Errors Due To Added Rifle Cant In The Field

If the rifle is held in the same attitude as while sighting in, the above errors hold. If, in the field however, the shooter has no way of knowing which way is "up" and the rifle is canted at a different angle from that held during sighting-in, an added error results. The analysis of this error is precisely the same as for the unadjusted error discussed above. That is, a cant angle differing by 5 degrees from that held while sighting-in causes a 0.70" lateral error at 200 yd, 1.116" at 300 yd and 1.53" at 400 yd. Vertical errors are again, in effect, nonexistent.

It is interesting to note that this error due to rifle cant increases with roughly the "square" of the range, which is about the same as for cross-wind deflection errors. We find, for instance, that in our above case, each degree of rifle cant produces about half as much lateral error as one mph of cross-wind component, at any range. This suggests a novel way of compensating for cross-winds. Instead of holding the proper distance up-wind, one could for example compensate for a 5 mph cross-wind by deliberately tilting the rifle nine or ten degrees up-wind.

Errors Due To External Scope Knob Adjustments

Shooters who correct for excess bullet drop by adjusting an external knob must be sure that the movement of the "vertical" or "up" knob does indeed move the sight line vertically. As most shooters know, making large vertical corrections by turning the vertical knob often also produces a small lateral movement of the impact point. This is because the axis about which the internal lens tilts may not be precisely correct.

To counter this, those who use this type of scope can deliberately cant the scope slightly so that rotation of the vertical knob does indeed move the impact point vertically. Otherwise the errors discussed above also hold in this case. That is, if moving the impact point 8.0" vertically induces a 0.70" lateral error, this indicates a 5 degree axis error. This could be nullified by canting the scope 5 degrees.

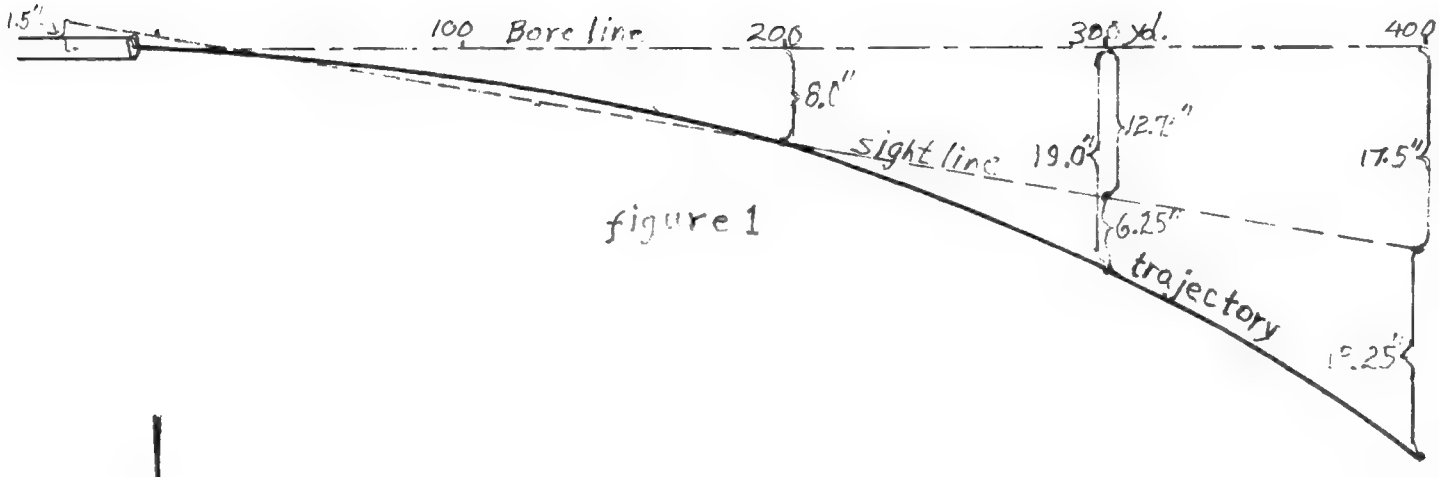

figure 1

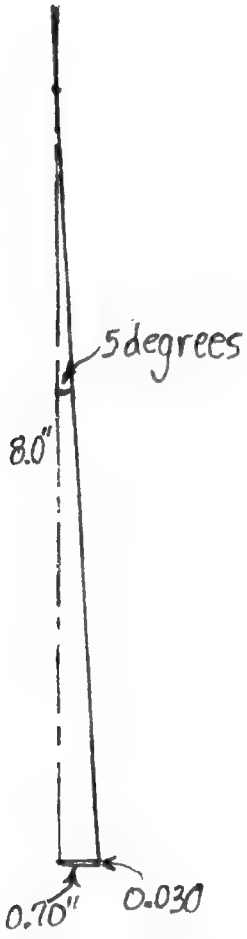

figure 2

MUZZ.VELO. 3100 fps,BALL.COEF .451

RANGE(yd)	0	100	200	300	400
VELO(fps)	3100	2879	2666	2462	2265
ENRG(ft#)	3201	2761	2368	2018	1709
PATH(in.)	0	-1.90	-8.00	-19.00	-35.75
ELEV(moa)	0.00	1.81	3.82	6.05	8.54
DFL/10mph	Xwind	0.64	2.67	6.24	11.57
TIME(sec)	.000	.100	.209	.326	.453

PAINT IT YOURSELF!

by

Bob Latino

If you're like me you probably have one or more fiberglass stocked benchrest, varmint or hunting rifles that wear a patina of battle scars. Does your favorite bench gun have its usual complement of "beauty marks"? You know - feeding port area scratched up from when the brass was flying during that time at the Nationals when that left to right was holding for about 30 seconds? Did you bung up the top rear of the butt area with your cleaning rod? Have you put Teflon tape on the forend and lower butt area just to cover up all those scratches from riding the bags. C'mon admit it! How about those varmint and hunting rifles? All scratched up from years of contact with Mother Nature's finest greenery. Yes, they still shoot well but look like Hell after all those years.

Do you cringe at the cost of new paint job? $80.00 is the LOWEST I've ever paid to have someone paint a stock. That was a simple single color base and clear coat job with polyurethane paint. Real fancy paint jobs by a pro can run over $200. And you have how many stocks that need paint?? Before whipping out your wallet consider painting it yourself. What did you just say to yourself - I can't do that - it'll look like hell! Well, how does it look NOW with all those battle scars? If you can accept the fact that you will not get a pristine, flawless job and the objective is to obtain a decent looking solvent proof and scratch resistant surface then you may be a candidate for painting your old stock. Don't have any spray equipment? Not to worry! Read on to see if you might like to give it a try.

Take a close look at that old stock. If it's not a glue in, remove the barreled action and trigger guard assembly. If it's a bench rifle with the action glued in - remove the barrel, scope, trigger guard and trigger. Examine the entire stock carefully - just scratches or is the paint chipped in places? At the 1996 200- 300 IBS Long Distance Championships at Weikert I glanced at one of Bob Sicina's rifles and what looked like a long scratch in the grip area turned out to be a CRACKED STOCK! You could see the crack open up easily if you put any pressure on the grip. Flex the stock to make sure its not cracked. Also listen for any kind of a creaking noise if flexed real hard. I've seen people rap on a stock with their knuckles or tap the butt end on a wooden floor listening for some sound - something like the way we used to tap a baseball bat on the ground as a kid to see if it was cracked. Unfortunately with some stocks having foam throughout their interior - some having partial foam - some with graphite - some without - some stocks using polyester resin as the cloth binder and some industrial epoxy - They're all going to have a different sound when rapped or tapped.

To start I like to clean the stock carefully with lacquer thinner or lighter fluid on a paper towel. This will remove virtually all traces of powder solvents, ammonia based copper solvents or stock waxes containing silicones or carnauba. Look at that paper towel when you're done. A smudgy brownish-black color you say? Do it again or until the paper towel stays pretty clean. Next wet sand the entire stock carefully with 220 grit wet or dry paper. Use a flat block behind the paper on the flat areas of the stock. Don't have a flat block you say? I use one of my loading blocks for this operation. Before you do, however, make sure the bottom of the block is not raw wood. Seal it with polyurethane. If you don't the wood block will WARP as water soaks in from the wet sanding process and your flat block may look like an arched bridge. In the curved areas a sponge backing sometimes works well. For real small cracks and crevasses wrap the paper around a pencil, screwdriver or anything that approximates the size and shape of what you are trying to sand. For the barrel channel area I sometimes wrap the paper around a large socket from a socket wrench set. Something like a 7/8 to 1 inch size usually works well. 220 wet, by the way, cuts faster than you think so wipe off the accumulated sludge often with a paper towel and check the condition of the stock - the objective here being to get down into the finish at or below the level of any scratch or chip. Use auto body filler if you have a real deep chip that goes all the way to the fiberglass surface. Just be sure to feather the edges of the auto filler into the original paint surface. Don't let them meet abruptly with a sharp line perpendicular to the surface. If you do they may pull apart later causing a slight crack in the paint's surface. Sand lightly with 320 wet and then wash the surface with clean water and paper towels until surface is clean. Allow surface to dry COMPLETELY. You can help it along a little if you like by using a hair dryer.

Now mask off all areas you don't want to be primed. For a glue in run a string or wire through the action area first and then mask off the action carefully. Use single edged razor blades or an Xacto knife to carefully cut off excess tape. Make sure the blades you use are sharp! Take the 2 ends of the string or wire and hang the stock in a suitable place where you can spray on primer. It's better if you attach the two string ends or wires to two separate points. If you run them together and attach at ONE point, the stock may rotate around that one point as you spray making it harder to direct the paint at the area you want. There are many suitable primers you can use. I like Krylon sandable automotive primer. It has a vehicle that dries very fast. You can usually handle the piece 15 minutes after you spray depending on ambient conditions. In 30 minutes to an hour you can sand the piece. Higher temperatures and lower relative humidities will facilitate drying. Make sure you wear a mask when spraying. The inexpensive round or triangular shaped spray masks work fine. Any store that sells paint will usually have them in packs of 3 for about $3.00. Some of the ingredients in certain polyurethanes and

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epoxys are highly carcinogenic (cancer causing). A couple of good whiffs of these straight into your lungs are probably worth quite a few packs of cigarette smoking. Due to the fact that I work with industrial epoxy on a regular basis making benchrest gunstocks I bought a Cabot NIOSH (National Institute of Occupational Safety and Health) approved respirator. They're about $40 and have replaceable filter cartridges but aren't really necessary for casual, infrequent contact with hazardous materials. Make sure the area you use to spray is sufficiently warm (check the label on the can) and well ventilated. Give the stock 3 or 4 coats of primer. Allow about 5 minutes between each coat.

Now that it's covered with primer you can see more clearly all the little pinholes in the surface. It's also easier to see surface "ripples" or uneven areas as you sight down the length of the stock. Are you sure you used that flat block on the flat areas? You can also block sand on large contoured areas - just roll the block around the contour. To fill the pinholes I like to use automotive "body putty". This is actually a thick red colored glycol based primer with a toothpaste like consistency that can be applied with a small plastic spreader. Bondo markets the product (their product number 933) as "instant scratch repair". You'll find it at most stores that stock auto body products. It dries quickly and sands easily. When all the pinholes are filled and the stock is dry, wet sand the stock again with 320 grit paper. Clean and dry the surface and reprime. Looks a little better this time doesn't it! - Surface smoother and almost no pinholes! Repeat the body putty, sand with 320, and reprime drill as many cycles as it takes until after reprimming your stock it shows no pinholes and is smooth with no surface ripples. Now sand the entire stock lightly for the last time with 400 grit wet. You're just trying here to smooth off that last primer coat. Even 400 grit can cut rather quickly if the paper is new and you press hard. Clean the stock carefully with plain water and allow to dry.

For your finish coat you have a few choices about what to do. First thing to do is forget about all conventional paints. Virtually everything, except polyurethanes and epoxys, will turn to "mush" if contacted by the strong cleaning solvents and copper removal products that shooters use (butyl cellusolve, nitromethane, ammonia etc.).

POLYURETHANES - Most automotive finishes today are base and clearcoat polyurethane sprays with an added hardener. They provide a chemical and scratch resistant surface. Polyurethane spray is easy to find in most hardware stores. This type, however, is made to finish wood and the few tests that I've conducted show that it is NOT completely resistant to chemicals used to clean firearms. One polyurethane I have used that is chemical resistant is the Pactra Formula-U polyurethane paints used by hobbyists that fly model airplanes.(Pactra Inc., 620 Buckbee St., Rockford, IL 61104-4891 Tel 815-962-6654) They need a paint that will withstand the caustic effects of the nitromethane that is mixed with the fuel used to power the model engines. Search out a hobby shop in your area to obtain the product. It comes in about 12 colors as well as clear. They make a nice Bright Red and a Midnight Blue that I have used. Hang your stock in a warm area and follow the instructions on the can. This paint levels very well even if you don't put it on too evenly. When dry it has one of the glossiest surfaces I've ever seen which is totally resistant to anything I've ever poured onto the surface. I've included some pictures of a new stock done in Pactra Bright Red. On the negative side it dries and cures slowly and is more prone to drips and sags in the finished surface. The outer surface will be dry and hard and the stock can be handled lightly in about 48 hours. The undersurface may not be properly cured, however, so continue to let it hang for a couple of days as I did the first time. I wound up with the waffle like imprint of the paper towels hardened into the paint's surface. Depending on color used you may not be able to cover the primer completely in two coats about 15 minutes apart. If you try to spray on too much paint at once you run the risk of sags and runs in the finish. If you get any small runs you'll have to be the judge as to whether the job is acceptable or not. A better way is to initially give the stock 2 coats the first time even though it may not completely cover the primer coat - let it dry 3 to 5 days - sand lightly with 400 wet - then give it 2 more coats. If you attempt to recoat too soon (before 48 hours) solvents in the new coat will penetrate the original coat and wrinkle the surface.

You can also try your own base and clearcoat with spray cans using a color you like in a flat or matte finish. I recently did a stock using ACE (from my local ACE hardware store) Glo Spray Fluorescent as the base coat followed by Pactra polyurethane clear. Spray the stock with the base color coat and let it dry completely. Check the label of the paint you use for dry times. The ACE Glo Spray dries very quickly and you can recoat over this surface with the polyurethane spray in about a half hour. These paints worked well together but the possibility of incompatible paint chemistries can occur considering the wide variety of paints available today. If that does happen you may run into sur-

Continued on next page

Left - Ace Glo Spray fluorescent paint used as a base coat.
Right - NYBCO Epoxy Paint for a $2.47 paint job!

Pactra Formula-U polyurethane hobby paint in Bright Red and Midnight Blue.

PAINT IT YOURSELF!

Continued

face wrinkling or partial adhesion. A good idea is to try this combination out first on a piece of plywood or a 2 by 4. If after a week or so it looks OK use it on the stock. Personally I've never had any trouble doing this but that doesn't discount the possibility of paint incompatibility. Interestingly enough instructions on the ACE Glo spray used as the base coat in this situation even RECOMMENDS an overcoat of polyurethane. Fluorescent pigments tend to lose color vibrancy after prolonged exterior exposure. The Pactra polyurethane will seal in the color richness. If the color you like doesn't come in a matte finish I see no reason why you couldn't spray it on anyway, wet sand with 400 grit to kill the gloss and then spray on the polyurethane. I have never done this, but it remains lodged in the back of my mind ever since I saw a beautiful glossy metallic blue spray paint at an auto store recently. Again, it's a good idea to try this out on some scrap wood first. It might work OK but you may not be happy with the look.

EPOXYS - Epoxy is even tougher stuff than polyurethane. If you aren't fussy about what color the stock should be, one easy way to get a scratch resistant and solvent proof stock is to use the type of epoxy paint designed to repair household appliances. Unfortunately, I've only found it in glossy white, glossy black or glossy almond. I get mine at Wal-Mart sold under the Nybco brand name for the princely sum of $2.47 a can. It has a medium drying speed and covers the primer well. The white Panda I shot throughout the 1996 season was covered with Nybco white epoxy paint. The finish was unmarred after a year of spilling solvent and the loading port seemed to resist the banging of cases better than a polyurethane finish. One night I left a little puddle of Shooters Choice on the top of the butt as a test. The next morning I rubbed the area with a dark cloth and no white was seen on the dark cloth. This paint for some reason seems more prone to give a slight orange peel surface. When it was dry I wet sanded it lightly with 400 grit to get rid of the orange peel and followed with some automobile rubbing compound. I ended up with a nice matte finish.

You can also use clear liquid epoxy as a clearcoat over a basecoat instead of the Pactra polyurethane. This will result in a surface that is extremely abrasion resistant. I have one varmint gun like this that I take into the field. After quite a few years the stock still looks good even though the gun has been bumped into more than it's share of obstacles provided by Mother Nature. Working with epoxy is more difficult however. First of all most epoxys, when mixed with their accompanying hardener, have a consistency of maple syrup and are difficult to apply by brush and impossible to spray unless thinned. A second problem is that nearly all epoxys are not truly clear but have an amber cast. One notable exception is the West System 105 epoxy produced by Gougen Brothers, Inc. (P.O. Box 908, Bay City, MI 48707-0908 - Tel 517-684-7286 Fax 517-684-1374). It is clear and has a low viscosity - about the consistency of 10 weight oil when mixed with its companion 206 slow hardener. You may find it at a marine supply store in your area. If not give Gougen a call for the nearest source. They also make the high strength industrial epoxy I use in making gunstocks. I've talked to their engineers over the phone a number of times and they have always been informative and helpful.

After the base coat has been applied

No, it's not Darth Vader! The author conducts a paint test outside on the sundeck protected by a cabot spray mask.

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and is completely dry hang the stock in a suitable area so that it cannot spin around. Put on a pair of rubber gloves and it's also a good idea to wear safety glasses. Mix up about 4 ounces - 5 parts epoxy to 1 part 206 hardener in a plastic cup. (If you use a different brand of epoxy the proportions will probably be different). When stirring the epoxy and hardener don't "whip " the mixture - you want as few air bubbles as possible in the combination. You now have about 20 minutes working time before the epoxy sets up. To increase time slightly work in a cooler area below normal room temperature and/or pour the epoxy into a shallow container that will give a 1/8 to 1/4 inch layer. I've had the best results applying the epoxy with a 1 1/2 inch urethane foam brush - it seems easier to get a more even coating this way. If you're not sure you can always practice again on that piece of plywood or 2 X 4. The West 105 epoxy levels well and don't get upset if you see a few air bubbles in the wet finish. Nearly all will "decant" or rise to the surface before the epoxy sets up. The thin layer you have applied will take 8 to 12 hours to fully cure. If you want to put on a second layer you have 2 choices. If the first layer has set up (becomes tacky) but is not completely cured (about 3 to 5 hours depending on temperature) go ahead mix up more epoxy, use a new brush, and apply the second layer. Anything over 2 or possibly 3 layers of epoxy on a gunstock, in my opinion, is overkill and remember each layer adds ounces if your gun is shot in competition and has to make a weight class. Most liquid epoxys, by the way, weigh about the same or slightly more than an equal volume of water. If you decide to put on a second layer after the epoxy has fully cured you must lightly sand (400 wet) the stock first so the new layer can make a chemical bond with the underlayer. If you don't the new layer will not properly adhere to the underlayer. When the final layer has fully cured (after 24 hours or so) you may notice a slight haze over the surface. This is caused by amines rising to the surface during the cure process. If you want to keep the glossy surface use an automobile paste wax with a cleaner to remove the amines. If you want to tone it down a bit you may want to experiment with massaging the surface with auto rubbing compound or some other mild abrasive. Again, it's wise to try out the effect on your plywood or 2 x 4 first to see if you like the results.

In closing, the final look of the stock will be predicated on the time put in and the skill to which the methods outlined here are applied. As I've stated earlier I don't claim the final outcome will look as nice as a job done by a pro. Your stock's finish, however, WILL be just as durable. Good luck!

Bob Latino
116 River Road
Rutland, MA 01543
508-886-6884

Authors Panda painted in NYBCO Appliance White epoxy paint.

New stock done in Pactra Formula-U from a spray can. Hole in stock is for custom weight system.

West System 105 clear epoxy with 206 hardener for the ultimate surface protection.

THE MEANING OF STANDARD DEVIATION

by

Dr. Philip Cassady, P.E.

The article in the August 1996 issue of ***Precision Shooting*** by Derrick Martin and Barrett Tillman entitled "Standard Deviation: Too Much Info?" struck a resonant chord with me. Several years ago I struggled to interpret the standard deviation in a meaningful way for the target shooter. I was interested in the standard deviation of group size rather than the standard deviation of muzzle velocity, but the lessons are the same.

The key is to realize that we are searching for the standard deviation of the whole population, and the only data we have concerns the standard deviation of only a small sample of the population. What we want is the standard deviation of a very large number of shots (the whole population), but all we can calculate is the standard deviation of a small number of shots (a sample of the population). The question then becomes: How well does the sample standard deviation that I calculate from 5 or 10 or 20 shots estimate the population standard deviation for a very large number of shots?

As pointed out by Martin and Tillman, the sample standard deviation calculated from only 5 shots can seemingly wander all over the place depending on which 5 shots you choose. It seems logical that the "error bounds" placed on the estimation of population standard deviation calculated using only 5 shots should be larger than the "error bounds" placed on the estimation of the population standard deviation calculated using 10 or 15 or 20 shots. Statisticians have determined a method to apply such error bounds, and the method is not very difficult to use.

What we have is the sample standard deviation that we calculate from a specific number of shots. What we need is the population standard deviation that pertains to a very large number of shots. The sample standard deviation is our best estimate of the population standard deviation, but how good an estimate is it? Statisticians have calculated tables that tell us how much larger or smaller the population standard deviation could be in comparison with the sample standard deviation. They define these error bounds in terms of "confidence intervals". For example, they can tell us the size of the error bounds above and below the sample standard deviation to be 95% certain that they contain the population standard deviation. In other words, we can be 95% certain that the population standard deviation, that we are looking for, falls within these error bounds around the sample standard deviation that we have calculated. As expected, these error bounds are much larger for small sample sizes than for larger sample sizes. It only makes sense that the more shots we include in our sample, the better estimate of population standard deviation we are able to generate.

Figure 1 shows the upper and lower bounds for estimating the population standard deviation from a sample standard deviation with 95% confidence (this is the usually accepted confidence level). The figure shows the ratio of population standard deviation to sample standard deviation as a function of the number of shots fired. If you fire only 5 shots, then the population standard deviation will fall somewhere between 0.6 times and

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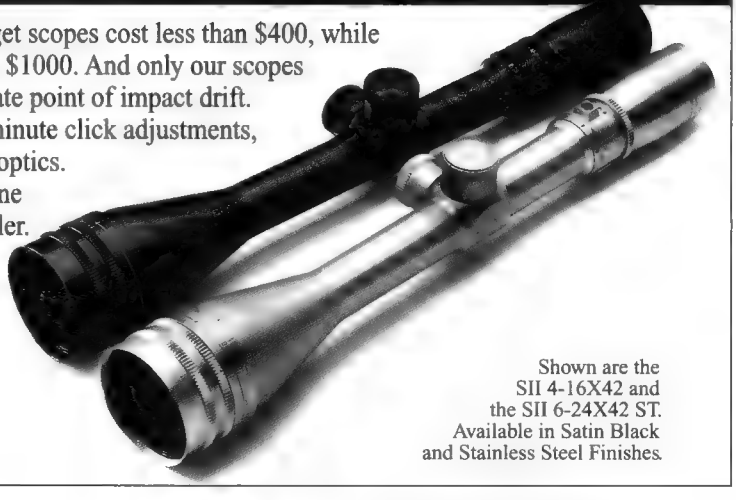

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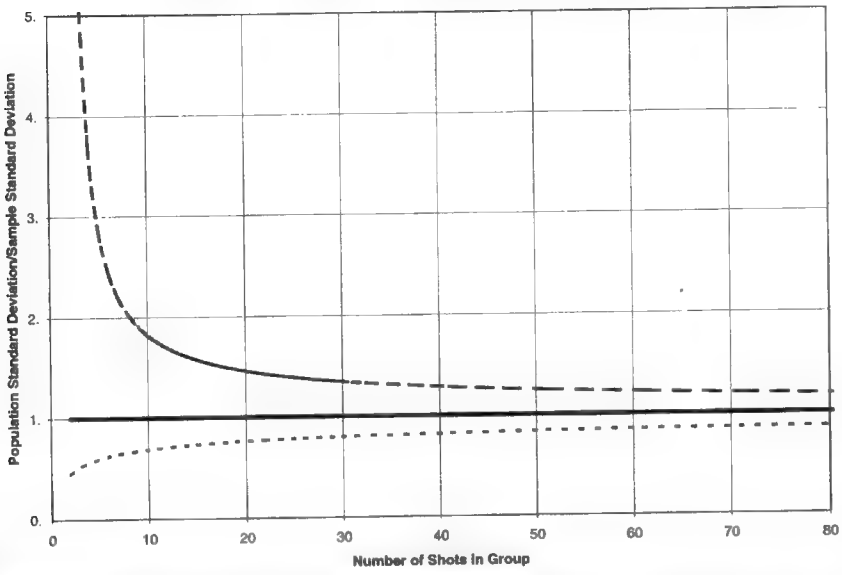
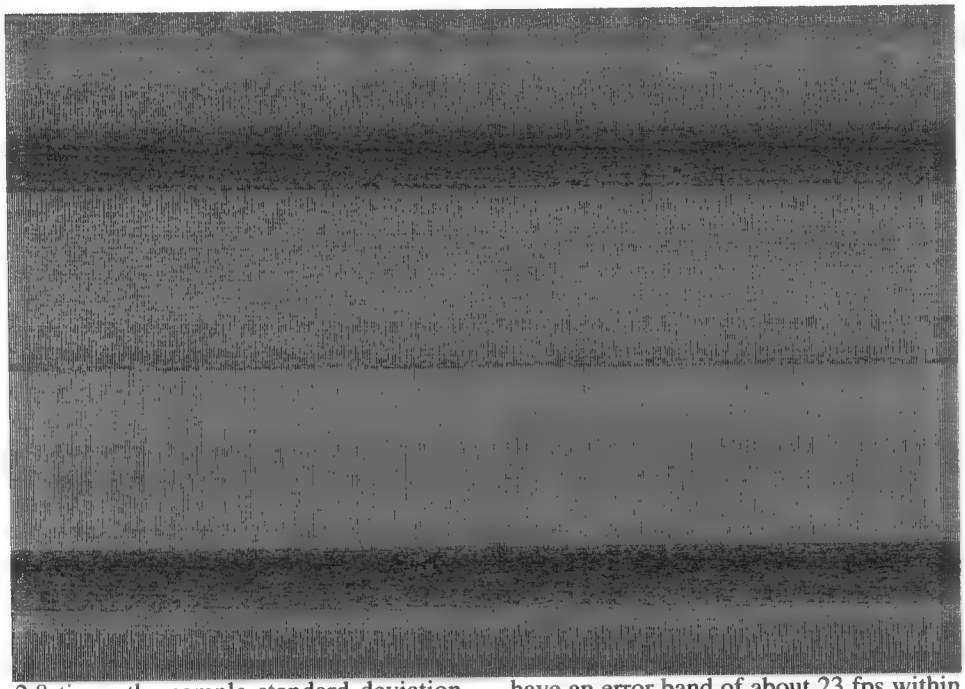
Figure 1: 95% Confidence Limits for Estimate of Population Standard Deviation





2.8 times the sample standard deviation calculated from these 5 shots. In the case presented by Martin and Tillman with a 5 shot sample standard deviation of 10.69*, we can only say that the population standard deviation lies somewhere between 0.6 x 10.69 = 6.41 and 2.8 x 10.69 = 29.93. That is quite a large variation, and the population standard deviation can be anywhere in that interval. Now let's look at their 20 shot string. If we use 20 shots the population standard deviation will fall somewhere between 0.76 times and 1.46 times the sample standard deviation calculated from these 20 shots. In the case of 20 shots then, the population standard deviation is expected to lie between 0.76 x 26.58 = 20.20 and 1.46 x 26.58 = 38.81. You can see that if we only considered the first five shots we have an error band of about 23 fps within which the population standard deviation actually lies. If we increase the group size to 20 shots we narrow the error band down to 19 fps. These large error bands explain why the sample standard deviation seems to vary so much from group to group.

In fact, our real interest is whether we can improve our consistency or accuracy by changing the characteristics of our load. In this case what we want to know is whether a change in load characteristics (different powder charge, different bullet, etc) has actually reduced the variation (standard deviation) in measured muzzle velocity (or group size). In statistical terms we want to know if the sample standard deviation of the new group is small enough to be sure that the population standard deviation of the new group is actually smaller than the population standard deviation of the old group. Statisticians have developed a method to answer this question, too. The results are shown in the second Figure. From Figure 1 we know that 5 shot groups have a lot more variation than 20 shot groups. Intuitively we would expect that if we are comparing two 5 shot groups, then the sample standard deviation of the second group will have to be much smaller than that of the first group in order to be sure that the second group is better than the first group. Figure 2 shows this effect. Anything above the line is probably just random variation and anything below the line represents a real improvement in performance.

Consider the comparison of two 5 shot groups, one shot with the old load and the second shot with a hopefully improved load. Figure 2 tells us that unless the sample standard deviation of the new load is less than 30% of the sample standard deviation of the old load we cannot be sure that there is any improvement. If we used two 5 shot groups and the sample standard deviation of the new load group was one half that of the old load group we could not be sure that the new load was any better than the old load. Variations as large as 70 % of the sample standard deviation could be generated by random variations in 5 shot groups, even for the same load.

If we compare two groups of 20 shots each, the sample standard deviation of the new load must be 63% or less than that of the old load to be sure of an improvement. Variations as large as 37% of the sample standard deviation could be generated by random variations in 20 shot groups, even for the same load. We would have to compare 80 shot groups to assure ourselves of a 20% improvement in standard deviation.

Just as Martin and Tillman have said, it takes a lot of shooting to verify improvements in performance. Statistics can be complicated, and their results can be discouraging, but at least they can tell us that we shouldn't believe claims of 50% or even 20% improvements in performance based on comparison of 5 shot groups.

(* My calculator gives sample standard deviations of 26.58 for 20 shots, 10.69 for the first 5 shots, 25.71 for the first 10 shots and 29.84 for the first 15 shots using the data published by Martin and Tillman. I don't know how they arrived at their published values.)

STANDARD DEVIATION: MYTH, LEGEND OR STATISTICAL ANOMALY

by

Mr. John Yarbor

Naval Surface Warfare Center, Crane Division

Crane, IN

Reading Derrick Martin's and Barrett Tillman's article in the August 1996 ***Precision Shooting*** started a thought process that led to reviewing reports compiled by the Naval Surface Warfare Center, Crane Division (NSWCCD) on 7.62x51mm match cartridges and then re-reading their article and re-reviewing the reports, ad nauseam. My hypothesis was that there is a direct correlation between the standard deviation of the muzzle velocity and the group size on target.

Martin and Tillman state that, "Virtually all service rifle records have been fired with Federal or M852" and that the people that fired these records "don't know or care about standard deviation". As an ammunition designer for the Navy, I would like to think that I care about standard deviation so that the Navy shooter does not have to. I would also like to state that not all data is the same. The article states that one needs to look at "hundreds of readings" before the true meaning of the standard deviation can be understood. However, one must take care that the readings are pure, ie taken under the same conditions (temperature, humidity, etc). In ammunition testing, reference cartridges are fired to correct muzzle velocity and chamber pressure measurements for temperature, humidity, etc so that test measurements at different locations or taken on different days are comparable. Be cautious of grouping data together that is not pure, however true statisticians would probably argue against comparing or combining corrected data.

When preparing a specification for a match grade rifle cartridge, the standard deviation of the velocity is usually not to exceed 25 fps. The sample size is between 20 and 40 cartridges. Typically, production lots demonstrate that the standard deviation of the velocity does not exceed 15 fps and continue to meet the accuracy acceptance requirement.

Back to the discussion at hand, recently NSWCCD started measuring velocity from test weapons and accuracy barrels when measuring accuracy. (However, as a practice NSWCCD does not fire reference ammunition in these particular types of weapons to obtain test corrections.) NSWCCD has an electronic targeting system, so that the order and position of each shot fired in a string is known. The logical step is to mesh the muzzle velocity data and the dispersion data and attempt to find a correlation between the two.

One of the reports reviewed summarized NSWCCD recent testing in support of the Marine Corps' M118 Special Ball Product Improvement Program. In support of this program, M852, 7.62x51mm Match and M118, 7.62x51mm Special Ball, Long Range (containing the 175 grain Sierra MatchKing™ projectile) cartridges were fired at 300, 600 and 800 yards. The M118 cartridges were also fired at 1,000 yards. Velocity and dispersion data were recorded for each range and cartridge type.

The attempt to find a correlation began by plotting the radial extreme spread of the group versus the standard deviation of the velocity for the group. This yielded a series of plots that looked more like shotgun patterns rather than the linear relationship that was desired and hoped for. A least squares analysis was performed on the data sets in the attempt to demonstrate a linear relationship. Only five of the 17 data sets evaluated demonstrated anything resembling a linear relationship. So, in the continued quest to demonstrate my hypothesis, vertical extreme spread was plotted against standard deviation and a least squares fit analysis was performed. Only six of the 17 data sets evaluated demonstrated a linear relationship. However, the linear relationship was stronger in the vertical extreme spread than in the radial extreme spread.

Let me digress to state that standard deviations of the five round targets ranged from a low of 5 fps to high of 27 fps for the M852 cartridges. This while the cartridges produced an average extreme spread of 2.5 inches at 300 yards, 7.5 inches at 600 yards and 10.6 inches at 800 yards. The M118 Special Ball, Long Range cartridges velocity standard deviations ranged from a low of 3 fps to a high of 16 fps, while the cartridges produced an average extreme spread of 2.3 inches at 300 yards, 6.3 inches at 600 yards, 9.9 inches at 800 yards and 16.0 inches at 1,000 yards.

So I began to look elsewhere in attempt to answer Martin & Tillman's question and prove my hypothesis. I pulled out another report, again on 7.62x51mm match cartridges. In 1990, the Navy was investigating the 170 grain Lapua Full Metal Jacket Boat Tail (FMJBT) bullet for use in a 7.62x51mm Match cartridge to replace the M118 Special Ball cartridge. A load development effort was under taken which evaluated several different propellants for pressure, velocity, accuracy and functionality. The velocity samples consisted of 20 cartridges each and the accuracy sample consisted of seven groups of five cartridges each. The data on various propellants generated has proven to be quite useful in supporting various match rifle cartridge programs since that time.

This program was conducted in three phases: evolution one, evolution two and sample verification. Several propellant loads were evaluated in evolution one, including IMR4895, IMR4064, AA2520, WIN748 and WIN760. Evolution two focused on increasing the muzzle velocity in an attempt to increase accuracy. The velocity was successfully increased, however poor accuracy results were obtained. Sample verification focused on chamber pressure, velocity, accuracy and functioning aspects of AA2520, WIN748 and WIN760 propellant loads from evolution one. Velocity testing consisted of firing a 20 round sample from a test barrel in accordance with SAAMI requirements. Accuracy testing consisted of firing seven each five round groups for record from each test weapon. The test weapons in this case were McMillan Model M86 rifles mounted in a sliding accuracy fixture.

Velocity and accuracy data was available from evolution one and sample verification for the following: 41.0 grains of AA2502, 44.0 grains of WIN748 and

46.5 grains of WIN760. (Note: This article makes no representation as to the safety of these specific loads. These loads were developed in a laboratory environment based upon the performance characteristics of the specific lots of propellant.) There was a procedural difference in the evolution one and sample verification loads. Each cartridge in the evolution one loads had the propellant dumped low and trickled up to the target weight. The sample verification loads had the powder dump set at the target weight and was verified for accuracy every 100 rounds. The following performance parameters were measured as shown in Tables I and II.

For the AA25200 loads, there was a 8 fps (80%) increase in the velocity standard deviation and a growth of approximately 40% in extreme spread at 800 yards. The 57 fps difference in velocity is attributable to a change in propellant lots. It is not considered that the change in propellant lots significantly contributed to the growth in accuracy since the bullet displayed adequate accuracy performance up to velocities of 2,650 fps. For the WIN748 loads, there was a 9 fps (33 %) increase in the muzzle velocity standard deviation and a growth of approximately 80% in extreme spread at 800 yards. For the WIN760 load, there was a 16 fps (100%) increase in velocity standard deviation and a growth of approximately 40% in extreme spread at 800 yards.

The following discussion is based upon a standard or bell curve, in which 98% of a population is expected to be ± three standard deviations from the average. For the evolution one sample of the AA2520 load, it would be expected that the maximum expected spread of the velocities would be 60 fps (based upon the standard deviation observed) and for the verification sample it would be expected to be 108 fps. The actual spreads were 31 fps and 38 fps, respectively. The maximum expected spread of the velocities for the WIN748 load would be180 fps for evolution one and 234 fps for the verification sample. The actual spreads were 105 fps and 142 fps, respectively. The expected spread of the velocities for the WIN 760 load would be 90 fps for evolution one and 186 fps for the verification sample. The actual spreads were 38 fps and 107 fps, respectively. In actuality, the actual maximum spreads were less than what was predicted. However, just as Barrett and Tillman allude to the firing of large numbers of cartridges, it can be reasonably expected to experience the maximum predicted spreads at some time in the life of the load.

So what can be said about standard deviation, is it too much information, myth, legend or statistical anomaly?

There was not sufficient data to prove the theory that there is a direct correlation between the standard deviation of the velocities of a five shot string and the extreme spread produced by those five shots.

However, there does seem to be a correlation between an increase in the standard deviation of the velocity of a twenty shot velocity test string and an increase in the average extreme spread of the five round groups. The correlation seems to be applicable to like propellant loadings rather than across the spectrum of all propellant loads.

Standard deviation of the velocity should not be considered as the single variable for determining if a certain propellant load is acceptable or not, unless an accuracy/velocity standard deviation history is known for that propellant type or load. Standard deviation should be compared to what is on target, just as Martin and Tillman stated that the proof is on target. One could make decisions based upon standard deviations for a known load with a proven history of standard deviation and accuracy.

For example: One has been shooting a certain handload well, for a period of time within an established standard deviation envelope. After preparing and chronographing another batch of this handload, it is noticed that the standard deviation has jumped say from 15 fps to 30 fps, one may want to consider what has happened. If it meets your standards, nothing is lost. But the increase in standard deviation could indicate problems with the propellant, primer, loading process or even the weapon.

Standard deviation is not too much information, a myth, legend or statistical anomaly, if it is used in its proper context.

Table I - Evolution One Results

Propellant Load	Muzzle Velocity (fps)	Muzzle Velocity SD (fps)	Extreme Spread @ 800 yd (in)	Extreme Spread SD (in)
41.0 grains AA2520	2,504	10	11.8	4.3
44.0 grains WIN748	2,598	30	10.1	3.8
46.5 grains WIN760	2,559	15	12.5	2.1

Table II - Verification Sample Results

Propellant Load	Muzzle Velocity (fps)	Muzzle Velocity SD (fps)	Weapon #1 @ 800 yds		Weapon #2 @ 800 yds	
			Extreme Spread (in)	Extreme Spread SD (in)	Extreme Spread (in)	Spread SD (in)
41.0 grains AA2520	2,561	18	15.8	5.7	17.8	3.2
44.0 grains WIN748	2,602	39	20.2	4.4	16.1	5.2
46.5 grains WIN760	2,533	31	14.4	6.9	20.5	4.8

HOW GOOD WERE HERTER'S WORLD-FAMOUS BULLETS?

by

Dave Scott

Given the extravagant claims Herter's concocted for its Wasp Waist Sonic Bullets a few decades ago, devoted readers of the Minnesota outfit's catalog must have been deflated by the subdued verbiage reserved for the remainder of the bullet line. In 1971 the Waseca manufacturer grouped nearly 50 of its conventional bullet designs, calibers and weights into a section modestly entitled "Herter's World Famous Jacketed Rifle Bullets". Yawn.

Nevertheless, Herter's managed to scrape together some salient reasons why we ought to order the more basic world-famous projectiles. A big part of it was purely monetary. "Herter's low profit volume policy takes the 'hokum' out of the bullet field," the thick catalog proclaimed, adding that high prices had stifled the shooting game for years. Well, make no mistake about it, Herter's priced its world-famous bullets to end all that stifling. In 1971 a box of .30 cal. 168-grain boattails was all yours for a mere $3.70. Or if 55-grain, .224" semi-points happened to fit your pet piece's barrel grooves, you forked over $2.30.

As an addicted Herter's consumer, I evidently thumbed right by the world-famous projectiles and long ago scribbled out an order for the infinitely more sensational (and slightly more expensive) Wasp Waist design in .22 caliber. I didn't realize this until I was browsing through

an ancient box of yellowing targets and observed some holes punched by the controversial bullets. Staring at the group dimensions, I clearly understood why the memory had been repressed. Even as I wrote an article on the Wasp Waist Sonics which appeared in the April, 1995 issue of ***Precision Shooting***, I was unaware I had previously tried those exotic projectiles.

That article, incidentally, brought a scattering of Herter's fans out of the closet. A trickle of nostalgic, tear-stained letters flowed into Granbury, each a bittersweet account of an encounter with Herter's products. Among the touching missives was a message from Bob Allen, Jr. of North Stonington, Connecticut, who had recently purchased the entire reloading inventory of a shooter in Rhode Island. Not just any inventory, mind you. The presses, bullets, powder, dies, powder measure, scale, trickler and more were all...Herter's.

Happily, he offered to send me a partial box of 50-grain, semi-pointed Herter's world-famous .224" bullets. "Care to give them a go?" Bob asked. Given that the bullets are long discontinued and most have doubtless by now been reduced to berm bits, I indeed jumped at his offer. I urged him to send the bullets in any container and keep the original Herter's box. Months later a package from Robert Lyman Allen, Jr. turned out to be the Herter's bullets in the lovely, original box.

While he was at it, Bob tossed in some aged Sierra and Remington bullets. The truly interesting items, however, were the Herter's 50-grain semi-points. After all, what kind of precision can a bulletmaker swage into its product when 100 bullets retail for just $2.30? According to my micrometer and scale, not a whole lot. The weights ranged from 50.1 to 50.6 grains, a mediocre 1/2-grain variance. Also troubling were the dimensions. My micrometer indicated the bullet shanks were .2238" to .2243", for a dismal .0005" variation. The majority measured a tad shy of standard .2240" diameter.

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Interestingly, the bullets exhibited no swell at the heel. In other words, unlike every other flat-base bullet I've miked in recent years, these babies have absolutely no pressure ring at all.

Oh sure, it's easy to pick on Herter's for piddling lapses in uniformity. What ultimately counts, however, isn't so much the precision of manufacture as how well the things shoot. I loaded up five rounds for the .222 Revenge, using my usual hunting charge of 26 grains of H322, with bullets seated into the lands and Federal Match Primers inserted at the other end. This rifle is built around a lightweight Shilen #5 contour barrel and a Kelbly Panda action glued into a Six benchrest stock. Attached here and there are a Jewell trigger and 16X Leupold. Using 52-grain Berger or Shilen bullets, the little rig shoots very well indeed. In fact, any time five shots at 100 yards bulge over the mid-.3"s, the thought of seeking solace in our local riflemen's support group crosses my mind. Hi, my name is Dave, and my shooting really sucks. Hi, Dave!

On a balmy winter afternoon, with the temperature hovering in the low 80s, I jabbed wind flags along my shooting lane to insure that I released each shot in a mostly prevailing 7 o'clock movement, rather than on the 5 o'clock shove of an aggravating 3-5 mph fishtailing breeze. Turned out that air flow was the least of my troubles, as the bullets scattered pretty much vertically to just over 1" on group #1.

Since four shots were fairly tight, I figured the Herter's projectiles deserved one more try. A few days later, under pretty dismal conditions due mostly to a 5-10 mph 9 o'clock wind, I fired group #2. This time, the Herter's grouped .95". Again, four shots were nicely clustered. Thoughtful evaluation of the results leads me to conclude that the key to making the 50-grainers perform to expectations is to fire four-shot groups. If you own a supply of the bullets, I leave it in your capable hands to figure out which four to shoot.

Finally, you and I must come to grips with the realization that we can't go about our dreary everyday lives until we finally put to rest the provocative question posed in the headline of this piece: How good **were** Herter's world-famous, albeit obsolete, bullets? Did, in fact, this little test poke a hole in the company's lofty assertions? Nah. The Herter's folks claimed the bullets were world famous, not accurate.

HEADSPACE AND OTHER MISUNDERSTOOD WORDS

by

Bob Greenleaf

In the June 1995 issue of ***Precision Shooting***, a thought-provoking article entitled "Case Strength and Back Thrust" was read with much interest. There were statements made with which I disagreed with, and originally I intended to write to Bob Jourdan personally just to express my own views, based on my experience; that is, what I've done in the past or what I've observed. They are my own opinions. They are not suggestions for others to follow, and just because Bob Greenleaf did this or that... someone else may not get the same result. The editor, when informed of my letter writing intention, dissuaded me, claiming that gentlemanly controversy is partly responsible for the magazine being successful. I hope someday I have the pleasure to have a beer or two with Mr. Jourdan and talk about guns and shooting. I'm sure I'll find the conversation beneficial for me, as I try to learn something new everyday. Okay, here goes...

Allow me to introduce myself. I am a retired product engineer who spent about a quarter of a century at Savage Arms in Westfield, Mass. A couple of my assigned projects were the complete redesign of the Model 110 bolt action rifle and some variations such as the Model 112V. Later I designed the Stevens Model 9478, a single barrel, single shot break-open external hammer shotgun, without rebound, but with an inertia firing pin - perhaps the safest firearm of that type. For awhile I served as Savage's representative on the Firearms Technical Committee of SAAMI. I am now a consultant doing design work and am frequently involved in both civil and criminal suits where a firearm is an issue.

In Bob Jourdan's article, he stated he had "the remains of a Mauser M98 that was totally destroyed with a standard loaded .22-250 cartridge when the headspace finally became too long, allowing the case to separate". In a few years I saw more burst actions than the average gunsmith will see in several lifetimes. Some were the result of accidents, and some I burst deliberately in experiments to learn certain things. Of course, I've not seen the action he reported, but I'll bet the receiver is undamaged except for setback in the locking lug abutments in the receiver ring. "A standard loaded .22-250 cartridge". Does that mean it was a factory loaded round or a reload assumed to be a "standard load"? I am certain it was neither. It was a cartridge that developed breech pressure far in excess of normal sporting ammunition or even Proof loads. The brass head extruded in to all the cavities he mentioned because of this extreme pressure. Headspace, excessive or otherwise, had no bearing on the damage. It is a good thing that this cartridge was fired in a M98. In almost all other actions the head would have ruptured, and the released gas would have burst the receiver ring or, at least, distorted it severely.

I agree that excessive lapping-in of the locking lug abutments in a M98 is not good practice as the hard case on the surface may be removed. The material choice in M98 receivers was deliberate, and for good reasons. Obviously, low carbon steel is easier to machine, but it is also very ductile which allows a lot of bulging and deformation rather than producing fractures that can cause serious injuries. An alloy steel receiver, heat-treated completely through, will have a higher tensile strength but will be less ductile and, therefore, subject to fracturing with high, suddenly-applied loads such as gas from a ruptured case head. Another advantage of a case-hardened part is smooth operation, or a lack of stickiness, that causes bolt cramping (which is important in rapid fire). In either case, the receiver will be ruined, but the shooter and bystanders are less likely to get hurt with a soft-cored receiver.

Excessive headspacing is not the menace it is widely believed to be. The main reason to keep headspace limits small is for reliable ignition. Around forty years ago I designed and had a rifle built using a 7mm cartridge based on the 7X57, but

Continued on next page

HEADSPACE AND OTHER MISUNDERSTOOD WORDS

Continued

with a shorter neck, a 30° shoulder, and a near-cylindrical body. I was warned that if I fired a 7X57 cartridge in that rifle the excess headspace would cause the gun to "blow up" and severely injure or even kill me. Well, I did and the gun didn't! The extractor held the case reasonably close to the bolt face, and I got ignition, a fire-formed case, and a smug look on my face. I have repeated that dozens of times since and always with the same result. I've never had a case fail from stretching while doing this.

While I was at Savage, I was asked to perform, at various times, experiments involving excessive headspace. I no longer have a copy of my report, but I do remember testing a Model 99 in 308 Winchester caliber with increasing headspace in .005" increments until "something happens". Misfires began to occur when the headspace was some .060" over MAX or around 1.700". Remember that the Model 99 has rear lock-up and stretches something like .010" when fired. There were no case failures or damage during this test.

Back in 1978, I was given the assignment of firing a 7X57 cartridge in a Model 110 rifle chambered for the .270 Winchester. We wanted to see what might happen if some a-bit-less-than-a-rocket-scientist type, out there in the hinterlands of this great country, was to bring about the less-than-auspicious marriage of mismatched cartridge and rifle... regardless whether the occasion was one of simple (indeed very simple) error... gross stupidity... or perhaps even advanced penury ("I'm out of money, no cartridges to be had for my .270... but what the heck... this one (the 7x57) looks close enough..."). It may have sounded, originally like a simple enough little assignment, but it turned out to be considerably more than a walk in the park. To simplify things a bit (every little bit helps) we went looking for a cartridge with the smallest (MIN) neck diameter that we could locate... and a rifle barrel with the biggest (MAX) neck diameter in its chamber that we could locate. The smallest neck diameter on a factory 7X57 cartridge that we could turn up was something like .3125". In order to go ahead with the test without using undue force (recall that this was all to see what might happen if some nitwit... using factory ammo... and a factory rifle... our Model 110... were to have things fall together in exactly the wrong set of circumstances. A one in a ten million shot perhaps... but firearms manufacturers are supposed to have plans in place to guard against one in ten million shots taking place). It was necessary to ream the neck of the .270 barrel to .3128" at the rear. While this might seem to be waffling a bit on the "factory" specifications, still... .3128" was the absolute "maximum plus" tolerance indicated on the SAAMI drawing for a .270 chamber. So, technically, we were within the parameter laid on us at the start of the assignment. Came test time, and the cartridge was inserted into the rifle, the bolt closed, and the gun was fired remotely, with the operator behind a barrier (no surprise there, surely).

The shot sounded completely normal, and the stock was undamaged. The only damage to the gun was the failure of the ejector retaining pin in double shear. One of the pieces of this pin caused the bolt to be difficult to open until the remnant became dislodged, and then the bolt could be opened readily. The primer was blackened, and gas that entered the bolt caused it to relock. Gas vented out the orifices provided in the bolthead and receiver. The head of the cartridge that was in the bolt head expanded about .020". The primer was extremely flattened, and it extruded into the ejector hole slightly. For this test we found that while it was a witless thing for anyone to try... still... and remarkably... the shooter would have been unharmed. **(But...don't you do it!).**

The S.M.L.E. rifles were allowed headspace .010" over maximum rim thickness. With a MIN rim thickness of .058" this gave a headspace of .016". Rimmed cartridges are the best for resisting excessive pressure, and because of their breeching a thinner web can be used safely.

Web thickness varies, not only according to the amount of support from the chamber that is available, but also the method of making the case and the hardness of the brass. Generally speaking, U.S. ammunition (centerfire rifle cases) have a head hardness of B88 to B92 which is in the range of 86,000 to 96,000 PSI tensile strength. The web thickness and the hardness are selected by considering the particular cartridge and the firearms that will use it. 8X57 brass has a thick web because of possible use in the old Commission rifles with their tighter barrels and possible mixed bolts. 220 Swift brass tends to run over .200" in web thickness, I've noticed.

Case strength, assuming the head is not butter-soft, is not as important as supporting the head of the case, because, as pointed out, brass has less strength than the barrel material. The Mauser Model 98 is the best ever made at surrounding as much of the cartridge with steel as possible. The only way to improve a M98 would be to go to push feed and a bolt head like the Post-64 Model 70 or my Model 110 bolt head. Incidentally, I did not copy the Winchester bolt head. We both copied Paul Mauser's 1895 patent. On the M98, the head of a case protrudes only .105", while the '03 Springfield had .147" to .1485" protruding. Pre-64 Model 70s are similar, to my knowledge. The Post-64 Model 70 and my redesigned Model 110 are in the .120-.130" range. The .30-'06 is regarded as a high pressure cartridge although it is not as high as some of the Magnums. A .30-'06 proof can reach almost 80,000 C.U.P. The minimum web thickness for a '06 case per Government specs was .184" so there could be as little as .036" of brass resisting the pressure. Most webs are thicker so there is more protection available than we need if we keep our loads reasonable and not try for the highest FPS. Longer barrels are the safest way to get higher velocity. Personally, I am not always prudent, and I admit it; therefore I like an action that puts the head of the case as deep into the barrel as possible. Hence, I prefer the Model 110 or the push-feed Model 70. The Remington Model 700 has the deepest bolt head counterbore, about .150", but the bolt nose enters a close-fitting barrel counterbore so if a case head ruptures that bolt nose will actually obdurate in the barrel. The bolt may be ruined, but there *should* be no injury. As a practical matter, whether the case is deep in the barrel or bolt head counterbore is really not of any great concern, as case head failures are rare and are usually the result of tipping the powder can too much.

The thrust of a cartridge against the bolt head or breech block, when fired, varies very little due to the amount of taper in the cartridge body. The .22-250 Remington has an included T.P.I. of .040". This is equal to 1°10' on a side. Some straighter cases such as the 308 Winchester have .012" inc. T.P.I. which is 0 20' per side or a difference of 0°50'. I looked in my trusty 1943 edition of "Marks Mechanical Engineers Handbook" and read-up on the coefficient of friction, sliding angles, etc. The angles we are dealing with on cartridges have no effect on the thrust. What does matter is the smoothness of the chamber, or lack thereof, and lubrication. As the

pressure rises in a fired cartridge, the ductile walls of the case expand outwards and want to cling intimately with the chamber, like the brake shoes inside the old drum brakes. If the coefficient of friction of the shoes against the drums and the area involved was greater than the coefficient of friction of the tires and their area against the road, then the wheels "locked-up" and the car skidded.

A slightly rough chamber, say 32 micro-inches, will enable the case to momentarily "lock-up" with the chamber. A surface finish of 8 micro-inches or less is too smooth and increases thrust on the bolt head. If the case springs away when the pressure returns to ambient, then extraction will be normal. In a situation with a very rough chamber the extraction mode may be very difficult, and in a gas gun a torn rim may result with all the usual nasty remarks.

The opposite situation exists when the case or chamber is not dry. The article had a chart showing the back thrust for various sizes of cartridge heads. This chart is correct for oiled cartridges that do not grip the chamber wall. For a dry chamber and cartridge the thrust is reduced 37%. Mr. Ackley's reported test of a .30-30 Improved in a Winchester is, frankly, laughable. DON'T TRY IT! The last sentence of that paragraph suggests that the gas pressure exerted nothing on the head; only on the sidewalls and the bullet - impossible!

There were a few occasions at Savage when we ran out of Proof cartridges in some particular caliber and had an order to fill. I would then instruct the tester on how to lube the cartridge body and neck with motor oil. This gave the bolt head a good jolt, and the headspace was rechecked to be sure it was still within standards. Getting the chamber really dry after Proofing in this fashion was a chore that had to be done before function firing was allowed. The company was pleased because the guns could be shipped, but I was told the workers had vile names for me. We were not concerned with the barrels as they had been Magnafluxed, and barrel steel had become so consistently good that Proof was only a formality. By the way, "Gun Barrel Quality" steel is only a mite less restrictive than "Aviation Quality", the top grade, and a premium is paid for GBQ Steel. A barrel failing due to a flaw in the material is almost unheard of today, especially if it is less than, say, thirty years old.

Proof testing always sort of fascinated me. Not that guns or barrels were blowing up regularly, but, rather, to look at the primers of fired Proof cartridges and marvel at how much they resembled the primers of my fired reloads or even factory loaded sporting ammunition. This taught me that you could tell, by the fired primer, if a load developed less pressure than a factory load *but not more*. The surest sign of excessive pressure is loose primer pockets. If the primer falls out after the first reload, it is *stronger than a Proof Load*, and the load should be reduced an absolute minimum of 10%. If the pocket is noticeably bigger (easier primer seating) after five reloads, the load is still too hot and should be reduced. The case should withstand ten or more reloads without greatly diminished primer seating force to be considered a moderate load suitable for most temperatures.

Another thing I observed was the frequency of some soul unwittingly trying to Proof a .223 Remington gun with .222 Remington Proof cartridges. They were easy to spot in the boxes of fired cases because the necks were only about 1/10" long. Occasionally a case would rupture near the original shoulder leaving a remnant in the chamber that had to be removed before reproofing with a proper cartridge. These case separations never caused any injury or damage other than a burnt ring in the chamber. They did not sound different. I know of Model 99s in .308 Winchester caliber being fired with .30-30 WCF ammo without injury or damage, but it's not a practice I'd recommend when you run out of .308s.

More random thoughts...

My first high power rifle was an interesting and good looking piece, but a poor choice. It was an early Weatherby built on a commercial FN action in 300 Weatherby Magnum caliber, #1201. Weatherby built it for me while I was Third Mate on a ship that used to call at Long Beach, California, a couple times a year. I would ride the trolley car to South Gate and nosey around his store, eventually resulting in my placing the order for that .300 Weatherby. I also bought twenty rounds of loaded ammo to get acquainted with the gun at a public range in the area. Weatherby had put on an early Weaver K-4 scope, but the reticle did not last twenty rounds. It was replaced with a Unertl 6X "Condor". All the primers fell out of the cases when they were ejected. The cases had been made by a domestic company, and the interior of the head was hemispherical. This caused the gas pressure to act at an angle to the head and opened the primer pockets even though the pressure was not excessive. I returned the 20 cases (one sectioned) and was given new cases made by Norma. I immediately sectioned one of those and found the web thin but conventional in design.

The maximum load listed in his brochure for the 300WM with 180 grain bullets and 4350 powder was 82 grains for use in the FN actioned rifles. When the new action with nine lugs came along, the load was reduced to 76 grains. (I wonder why?) I fire-formed a lot of cases for that rifle using .300 H&H brass, but lost a few when reloading until I learned how to adjust the full length die correctly so as not to set the shoulder back too much. Doing that a few times causes head separations. Removing the remnant from the chamber can be a chore, and the chamber gets a burned ring that should be polished out. I feel belted cases are a poor idea, and the new cases based on the .404 Jeffery are a step in the right direction. If I was still a hunter I'd get a .300 Imperial Magnum rifle (a .30 caliber cartridge based on the .404 Jeffrey-unbelted-case) and would be ready for anything in North America.

The Weatherby rifle? Around 1954 I bought a Winchester Model 70 in .30-'06 which seemed a more practical choice, but used it on only one deer (a huge Muley), and then started to use my 7mm VAR (mentioned in my June 1995 ***PS*** article). I finally traded the Weatherby for a Valmet Finnish Lion .22 LR match rifle when I got the small bore bug.

The article on the .224 Weatherby Magnum (I tended to bounce around a bit in my areas of firearm interest) in the June issue of ***PS*** had some strange dimensions for diameters of large rifle primers. They may have been typographical errors. (Editor: They were). To my knowledge, the standard for L.R. primers is .2105" to .213", and the upper limit, while rare, is allowable. I can't even imagine a .219" diameter primer! It is too bad Creighton passed away. He would have liked to include them in his study of primers and seating forces! (*Editor: Sarcasm will get you no place around here, Greenleaf...)*

I agree it is preferable to have the cartridge and the chamber close to each other in regards to headspace as it promotes accuracy and longer case life. Excessive headspace is not a menace to be feared. At worst it is a nuisance, in my experience.

(Editor: The writer, an experienced veteran of the firearms industry, presents here his views on headspace. It is not an area recommended for experimentation by the novice).

BLIND SQUIRRELS AND ACORNS

by

Jim Jordan

When you haven't done any shooting in over twenty years, a lot of things change. I retired from the Marine Corps in 1973, and the only time I had been at a range was to check out a couple of handguns I had bought for self protection. Two years ago I took some CCI Blazer ammo, and a Ruger 10/22 (that I had never fired) to our local gun club range to pop some caps. When I arrived I noticed a few fellows in my age group with some fancy equipment, shooting really small groups. I thought some one should show them how to adjust their scopes, since most of the groups were low in the Eight ring. Well, I had just discovered Benchrest Shooting. My previous efforts in the Corps had all been service rifle position shooting, and these old bones had long since given up on the torture required to compete in this discipline. But maybe I had just found the answer to an old shooter's prayer. I could sit at a bench, rest my rifle on an infinitely adjustable front device, use a 36X scope to compensate for my failing eyesight, and proceed to shoot tiny groups that would have been impossible with my Garand. Talk about a new lease on life.

Since the Corps had always furnished my ammunition, I had never had the need or the inclination to learn reloading. A couple of guys at the gun club I joined reckoned that they could point me in the right direction. I was introduced to ***PS*** magazine, Glenn Newick's book, the Bob Pease Collection, and to Russ Haydon. Reading through four years back issues of ***PS*** also gave me a lot of information on how to get started. I couldn't wait to buy a rifle, so I researched the best ways to select a "One Hole Shootin'" piece of Benchrest Musketry. I read past articles by both the ***PS*** Editor and Dick Wright/Wong, and then proceeded to ignore the sage advice of both. This was a mistake that would ultimately cost me time and money. What I did was to rush out and buy a used Shilen sleeved Heavy Varmint Rifle, with a 722 action in triple deuce chambering. Now this is a great old gun, and it shoots really well. The problem is I ultimately decided that I wanted to start shooting Hunter Class. Obviously the Red Baron (as I had named the Deuce) would not meet Hunter Rifle requirements. Time and Money, Time and Money.

I joined the NBRSA, since they are the dominant Benchrest organization out here, (California) and proceeded to search their Newsletter to see which Gunsmiths were making the top ten in the Hunter Class equipment lists. One name that consistently showed up was Steve Kostanich of Chehalis, Washington. I contacted Russ Haydon, whose opinion I trust, and asked what he knew about Steve. Russ told me Steve was a top gunsmith and made fine rifles. (I can now confirm this based on personal knowledge.) I called Steve and explained I wanted a Hunter rifle, but did not have the experience to know what I wanted, needed or could afford. Steve took the time to explain my options, the costs involved and made some recommendations. We agreed I would furnish him a Remington action which he would accurize. He would build me a tight chambered 308 Winchester. (In a copy of "The Best of PS", I had read Marcy Lyon's article on the calibers *real men* shoot, so I had to have a "thoity".) We selected a Dan Lilja barrel with a 1 in 14 twist, a Jewell 2 oz. trigger, a Lee Six HBR stock, Sako extractor, and a custom paint job by a young fellow named Scott Minugh. Steve was going to put Kelby rings on, but turns out they were in short supply at that particular point, so he used Outbacks instead. This was in March, and I explained that I wanted to shoot the NBRSA Nationals being held in Portland, Oregon in August. Steve said the rifle would be ready mid-June, which would allow time for break-in and load development.

The rifle was to weigh in at under 10 pounds with a Burris 6X HBR Scope. I contacted Bill Dalley of Coloradoptics and ordered the scope with a .375 target dot. When the scope arrived, I mounted it on the "Red Baron", and went to the range to see what the world looked like in 6X, after the magic of 36 power. Well, it didn't look good. Matter of fact, I couldn't even see the damn dot. I called Bill, explained the problem, and returned the scope to him. Burris's checkout revealed nothing wrong, so it must have been my eyes. Bill said he could get the reticule converted to a fine plex for a small fee. I went with the conversion, and am quite happy with it. The target looks pretty small, but at least now I can see the crosshairs.

While my rifle was being built I sent in my registration fee for the Nationals and proceed to try and get ready for the shoot. Russ Haydon set me up with brass, dies and all the items (real or imagined by me), to produce quality handloads. Through trial and error, phone advice on neck turning from Dick Wright, and the destruction of a large number of Winchester cases, I finally managed to produce some acceptable brass for loading. When Steve and I were designing the rifle, we decided I would shoot light (125 and 135 grain) bullets. Rumor Control had it that Guy Chism in St. Louis was making some great light weight "thoity" bullets so I called him and placed an order.

Mid-June arrived and so did the rifle. If a thing of beauty is truly a joy forever, then this rifle will be making someone happy long after I leave the range. Steve had done a beautiful job, and Scott's paint job was magnificent. I understand Scott works at a body and fender shop, but I have the feeling that as his work becomes better known, he has a bright future in the custom stock painting business. My feelings were, that if I could shoot this rifle half as good as it looked, then I would be in fine shape.

The remainder of June and all of July were taken up with breaking in the barrel, and developing a good load. I am now a believer in the very tedious and boring, shoot and clean, shoot and clean, break-in method for new barrels. This 30 caliber Lilja just does not foul. I did lots of testing with W748 and 4895 powders, and with various seating depths and primers. The load of choice turned out to be a Chism 135 grain bullet, backed up with 45.5 grains of H4895, a standard Winchester primer, set up to just touch the lands. This load was developed specifically for this rifle, and should not be considered a recommendation for other rifles. Initially getting this rifle to shoot for me was difficult, and I attribute this to my inexperience in load develop-

ment and some mistakes I was making with bench techniques.

I put a 36X scope on for testing loads, because I didn't feel I could trust my eyes to tell me the truth with the 6HBR. I thought I had a pretty good load developed, but I kept putting three or four shots in a really tight group and then one or two out. Over and over this same combination was showing up with the "out" shots being verticals. I was going nuts, when John Sanders (a shooting buddy of mine who has since left the range) gave me an old copy of Warren Page's "The Accurate Rifle", and told me to read the chapters on "hard kickers, and table techniques for heavy calibers". Well the answer for me was right there. My recent shooting had all been rimfire, and the mild recoiling Triple Deuce, which I had been shooting free recoil with reasonable success. Given the much stronger recoil of the 308 (a *real man's* gun), I was taking a death grip on the stock, and was using a lot of shoulder pressure on the butt to offset the kickback. I went back to shooting free recoil, and things immediately got better. A whole lot better. Free recoil was however causing my middle finger behind the trigger guard to take a real beating. Taping it with electrical tape and a small square of foam rubber solved that problem. I do not find the shoulder recoil at all objectionable.

At about 200 rounds fired, this barrel seemed to come into its own and really start shooting. It seemed to shoot better in the wind, and to be more forgiving of my mistakes. I am not even remotely suggesting this might be a "hummer". I'm sure I would not recognize one if I were to trip over one. I do however believe that after two hundred rounds this rifle started shooting better than I can probably shoot it. Anyway, I mounted my 6HBR scope, shot some "50's" on Hunter Targets and felt I was ready to take on the Nationals.

Portland, Oregon is about 550 miles from our home outside of Old Hangtown (Placerville, CA) in the foothills of the Sierra Nevada mountains. Since the Nationals would be shot over three different yardlines on Saturday, Sunday and Monday, my wife and I decided to leave on the Wednesday before the match. We would spend one night on the road, arrive in Portland on Thursday and I would have all day Friday to get squared away.

We arrived about noon and checked into our motel, which was about a 15 minute drive from the range. After lunch we went in search of the Tri-County gun club and found it quite easily, thanks to the directions furnished by registrar Judy Schwantes. My wife, who doesn't shoot, was along as navigator. The members of this club have an excellent facility in a beautiful location. Set among tall trees, everything was lush and green. It was obvious to a Californian that these folks get a lot more summer rain than we do. Both my wife and I were tired from our trip so we headed back to the Best Western for a good night's sleep.

The next morning I arrived at the range at about O'Daylight Hundred and was surprised to see the place was already a buzz of activity. Since this was my first shoot and I didn't know anyone, I found an empty bench and proceeded to set up my gear. The loading area was actually the shooting benches of a range adjacent to the one we would be using. As I unloaded, I found myself in the middle of a bunch of real "Bozos". Seems I had landed in the midst of Jim Guedmin (General Bozo) and the Redwood Team of Shooters from the American Conference of Transcontinental Hunter Rifle League. These guys had Bozo hats, were all shooting something called the "30 Bozo", and were talking about entering the "BOZONE" (at the time I figured they were all in the Twilight Zone). Later it was revealed to me that the BOZONE was that rarefied state of shooting high X count, perfect 250 scores. Needless to say I enjoyed the easy banter and endless ribbing the Bozos gave each other. I received an invite to come up and shoot at their facility and intend to make the trip sometime in 96.

After setting up my reloading gear, I took my rifle down to the firing line to check out my gear and loads for tomorrow. I was competitor number 210 (2nd Relay, Target 10) and since no one was on my bench, I proceeded to make my final adjustments. From the number of windflags already set up, it was obvious that a lot of shooters were here at the Nationals. The firing line had 20 benches, and I had been told we would have 5 relays, which would make this the largest NBRSA Hunter Nationals ever. Since there was very little wind, my task was quickly accomplished. I saw no reason to waste ammo or shoot out my barrel, so I stored my rests behind my bench and returned to the loading area.

After rifle cleaning and reloading, I drifted over to where Russ Haydon had set up his store. While Russ and I had spent a lot of time on the phone together, we had never met. He said he wasn't competing this trip, but would do a little business and renew some old friendships. I bought myself a bolt holster (I had never seen one before) and ran into Gunsmith Steve Kostanich. Steve introduced me to Scott Minugh, the fellow who had painted my stock. Both were real nice fellows and accomplished shooters. (From reading the ***PS*** Editors comments, I always though Gunsmiths were an ornery lot who didn't like phone calls and yelled a lot.) (Editor: I stand by my story).

I'm not real good at initiating conversation with people I don't know, but Scott's paint job was a great ice breaker. All morning people were stopping by and admiring his work. I later heard he got several orders for custom paint jobs. One really nice fellow named Marcy Lyons stopped by to chat. We discussed all the flack he had received from the 6mm shooters after his comments on shooting the thirty calibers. I met Clark Greene and Marv Roberts, who would ultimately finish 2nd and 3rd in the Grand Agg. Had a chance to talk to Lowell Frei, a Varmint Class shooter of some renown and met ***PS*** columnist Bill Bartram, another very interesting fellow. While I'm not Will Rodgers, who "never met a man he didn't like", I can honestly say I never ran into a nicer group of people, and I really enjoyed their company.

Saturday morning dawned clear and warm. Hot actually. While it wasn't blowing up a storm, the wind was switching a lot and looked pretty tricky to a novice like me. I checked all my gear and tried to tell myself that this was no different than an shoot at my local range. *BS, this was totally different!* It was my first registered match, it was the Nationals, and there were a lot of big name shooters here. Please God, don't let me finish dead last and completely humiliate myself.

One good thing for me was that with 5 relays, I would have about an hour between matches, which would give me plenty of reloading time. After each match we would rotate benches by 4 numbers. I would go from bench 10 to 14 to 18, etc. Target number boards were color coded so even though we were rotating, we would always be shooting on the same color. This was an aid designed to help reduce the chance of crossfiring.

My warm-up match was called and I went to the line to setup. When one relay is coming off the line, and another is going on, you get to know the speed and habits of the guys on the relays before and after you pretty well. Relay changing time is a bit hectic, especially when target rotation is also in the equation. One person is attempting to remove and move all of his gear to the next bench area,

Continued on next page

BLIND SQUIRRELS AND ACORNS

Continued

while another is setting up to shoot. In the case of our 20 bench line, we had 40 plus folks dodging and weaving like Heiseman candidates in late November. (Editor: You will - eventually - love it at The Super Shoot, with 60 benches, at relay-change time. Three shooters are still missing from last year's match).

When the rangemaster gave the commence fire, I shot a fouler and then two quick sighters, to check things out. The wind was not blowing that hard, but was still switchy and you had to be real careful with your condition. I found the flags I felt were going to give me the best read, decided on a condition and started to shoot my record bulls. I don't know how everyone else shoots a Hunter Target but I shoot the sighter in the lower right of the target, shoot up the right side, cross over and shoot down the left side. Since my condition was holding, I shot fairly rapidly and ended up with about 5 minutes of extra time. I had shot a 9 on my first record bull and then the rest 10's for a 49 in the warm-up match. Not earth shakin' shootin', but not last place either. No one seemed to be pointing at my target, and laughing raucously, anyway. I was feeling a little better and starting to relax a bit. Rifles were weighed in after the warm-up match and mine came in at 9 lbs, 12 ozs, easily making the 10 lb limit. After rifle cleaning and reloading, I found I had about 40 minutes till my next match.

I got my 50 in record Match 1, in what I felt to be fairly difficult wind conditions, but was unable to buy an X. In Match 2, I duplicated my 50, and picked up 2X's. In both matches, I had been able to find my condition and get my shots off quickly. I was shooting a lot of scratch 10's, with a few X's, but you take them "50's" anyway you can get them. I shot 10's on my first two shots in Match 3, but just as I let my third shot go, I saw my key flag drop dead. I went to my spotting scope hoping to find a scratch nine, but I was well into the 8 ring. My last two shots were 10's, and I finished with a 48 in Match 3. I kept rotating benches, and I shot 50's in both Match 4 and 5. This gave me a fairly respectable 248, albeit a very low 6X count, for the 100 yard event.

It turns out that conditions had been difficult for everyone. Of the over 80 shooters, consisting of some of the top guns in the country, no one had fired a 250. Seven shooters had 249, with James Angle (the ultimate Grand Aggregate winner) winning the 100 yard competition by virtue of his fine 17X count. I was the low 248 shooter with 6X's, and had shot my way to 23rd place. I think about this time my 1984 Detroit Tigers Baseball cap started getting a little tight. (Must have been shrinkage due to the effect of the Oregon humidity.) Hell, I was only one point and some X's (that's usually what score events are won or lost by, points and X's) out of the lead while shooting in fast company. If I could (if'a, could'a, would'a, should'a) only shoot another 248 at 200 yards tomorrow, I should (should'a) be in contention for the lead in the Grand. For sure I would be able to finish in the Top 10. Shucks, this registered competition shooting ain't so tough after all. Maybe I'll start putting together a modest Trophy Acceptance Speech tonight... just in case.

I organized my gear for the next day's shoot, and drove back to the motel. After dinner I was wandering around outside and ran into Clark Greene. We talked about the day's results (Clark had fired a 248, 13X for 10th place), and how we hoped conditions would settle down a bit. I mentioned I was shooting Chism bullets, and it turns out he and Clark are best friends. I was interested in the construction of his wind flags, so he sent me the plans after he returned to Missouri. Clark is an experienced shooter and he reinforced my "one shot out of the lead" theory, and said anything could happen. As it turned out, this was to be a prophesy I could have lived without. A few more shooters joined us, we BS'd for a while longer, said goodnight and retired to our rooms. I didn't sleep very well. I kept having visions of accepting plaques at the awards ceremony on Sunday.

Going to the line for Sunday's 200 yard warm-up Match, the wind seemed to be a little less switchy. I felt I had a good shot at making up my one point deficit, and was determined to do well. I shot a 49 in the Warm-up, and really didn't know what had caused the point I lost. I had not seen anything in the flags to explain it. I've been using one of those $39.00 Russian Spotting Scopes, and it works real well at 100 yards. I was however having difficulty picking up close line shots at 200 yards. Maybe a quality Spotting Scope will find it's way into my stocking this Christmas. (Big Hint.)

When I went to the line for Match 1, the wind was light, and the predominating condition was the same as the warm-up match. My sighters were on, the condition held, and I put all 5 shots down range in a hurry. There was one shot I wasn't sure of, and Marv Roberts (my neighbor two benches down) checked with his (better) spotting scope and said all shots were 10's.

After cleaning my rifle and reloading, I went to the Wailing Wall to check my target. Sho'nuff, I had gotten my 50 with the help of a couple of scratch 10's. No X's, but I was very happy with the score. While I should have (should'a) kept focused on shooting, I got this idea to check on yesterdays leaders and see how they fared. Well none of the seven shooters who fired 249's yesterday had fired a 50 in Match 1 today. Guess what Shooting World...I was tied for the lead in total points, though behind in the X count. Just keep shooting 50's and anything can happen. I'd rather have a 250 with no X's than a 249 with 24X's any day. Ah, life is good and I am so deserving.

Match 2 was called, and I moved my gear to bench 14. The target crew comes back, and the Rangemaster gives the commence to fire. I go to my sighter, the 10 is there, so I proceed to rapidly shoot my record bulls. A quick check with my spotting scope. Way to go...I have my 50 again! About then, someone taps me on the shoulder. It's the Rangemaster, and he says, "Excuse me, but are you firing on the right target?" Somewhat indignantly I tell him of course I fired on the right target. "Well," he says, "someone just put a fast 6 shots on Target 10," and he returns to the center of the line.

I go to my rifle scope to take a look, and I am sighted right on Ahhhhh Target 10. Damn! And double damn! I had rotated to Bench 14, but I had sighted in on and fired on Target 10. This is crossfiring big time you "dunderhead"! (Read this word in last month's ***PS*** Editorial and liked it). I called the Rangemaster back, confessed my sin, and apologized profusely. He was quite sympathetic actually and didn't yell, scream or hit me. All I wanted to do was sneak away and hide. Instead, as soon as the cease-fire was called, I walked down to Bench 10 and offered my sincere apologies to the young fellow whose target I had decorated with my crossfires. His name was Jeff Lotto, and he was far more understanding than some others might have been under similar circumstances.

After I took my gear back to the loading bench, I went in search of the referee. Under NBRSA Hunter rules, I would lose one point on my first bull, and receive zero points for each subsequent crossfire. This would give me a score of 9 points out of a possible 50 for Match 2.

The best laid plans of mice and men! There was no way I could begin to make up a 41 point deficit and besides the wind was pretty much gone from my sails. I was feeling sorry for myself, angry at myself and in general lost all desire to continue the shoot.

A number of people tried to make me feel better by sharing their own crossfire experiences, but it was of little consolation. I had just made a dumb mental mistake in the Nationals and I'd be damned if I was going to let anyone make me feel better. Someone told me that there were two kinds of shooters. Those that had crossfired, and those who would someday. Another guy saw it as those who would admit it, and those who lied about it. Anyway, I didn't feel much like shooting anymore. So I packed up my gear, said bye to the Bozos, and returned to the motel. Since we were leaving the next day for Idaho, we decided to get a half day's jump on the trip and leave early.

By the time we got back home, I was feeling better. All things considered, I had shot beyond my expectations at 100 yards, and had the experience of competing at the National level. I had met a lot of really nice people, who I would like to shoot with again, and I had learned how much mental concentration plays in this sport. There is a saying that "Even a blind squirrel will find an acorn occasionally", and I'm sure that happens. My Dad used to say, "The harder you work, the luckier you get". I don't believe that there are many blind squirrels winning Benchrest competitions these days. I believe that the people who are winning almost always deserve to win. They are getting into the winners circle by virtue of hard work, experience and persistence. These are people who are willing to pay the price.

I recently purchased a used Light Varmint Rifle in 6ppc, and it's currently back east with Jim Borden for some adjustments. I want to shoot some group matches in Visalia next year, and I have sent in my registration for the Cactus. Guess I'm hooked. I also plan on shooting the Hunter Nationals in Porcupine, SD next year. I've been looking through my road atlas, and where the hell is Porcupine, anyway?

(Editor: Actually it's more of a state of mind than an actual place...)

Semper Fi,
Jim Jordan
3687 Montclair Rd.
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RETURN TO THE *SKEDADDLE LONG RIFLE CHAMPIONSHIPS*

by

Joe Cerami

Dear Dave,

Over the past year I have come to realize what a heck of a commitment of both time and money it takes if one has the terminal misfortune to become carried away with the romanticizations that appear monthly in these hallowed pages... and then decide... "I want one of those. And I want to do that. And the sooner the better".

It was just a short twelve months ago (and a ton of money ago) that I called you to inquire just where my father in law, Ray Browning, and I might go to watch a real-honest-to-gosh benchrest match. At that distant point in time (or so it seems) we were just a couple of hayseeds who would happily drag out our portable bench on Saturdays, and test our latest brain storm that we worked up/whupped up/theorized up during the prior week in our reloading room. Much of the preceding two years had been given over to what we now know was an early exercise in Mission Impossible (the recent hit movie of the same name was but a shadow of what we actually went through)... namely the attempt to get a Winchester Model 70 synthetic in 300 Winchester Magnum to shoot consistently under an inch at 100 yards. After two years of blood, sweat, tears, fits of manic depression, suicidal tendencies, and towering rages... we gave up. Are we quitters, you ask? After two years of trying... hell yes!

Flash forward to the present point in time. Our fate is sealed, our doom is upon us, seemingly. One foggy January morning, in Eureka, California... we were allowed to shoot a real benchrest rifle. We will never be the same again, nor will any of our linear descendants. Now all I want to do is shoot, load for, and talk about "Extreme Rifle Accuracy" (There's that phrase again... it's stuck in my mind... I've got to stop using it... it now pops up in about my every third sentence...) and read and re-read the newest issue of ***Precision Shooting***. (Editor: As the late Dr. George Sheehan expressed it so very well... *"Life is that portion of time that we spend between races"*).

As a result of our graciously being allowed to fire someone's real benchrest rifle, and as a result of the adverse influence that this magazine has had on our thinking, just how far have we been led astray from Mainstream America since that foggy January morning? Well, let's see... we have...

1. Purchased and remodeled a couple of rifles for squirrel hunting.
2. Ordered a pair of Hunter Bench rifles from Larry Smart.
3. Shot the Hunter postal matches for the Manila team.
4. Planned and have started to build a pair of 280 Improveds.
5. Drafted plans for a 12 bench covered firing line.
6. Solicited donations from trade and business associates, to fund the construction of the firing line.
7. Worked on finding a place to build this range so we can start benchrest competitions in our county.
8. Have formed the I.B.S. (Intermountain Benchrest Society. Membership, photo #1).
9. Organized the tenth annual "Skedaddle Long Rifle Champion ships".

Yes, Dave, it has been a busy year for us but we have enjoyed it. What, you ask, has started us on this treacherous path? The answer unequivocally is the Skedaddle Long Rifle Championships. Before you ask, I'll explain a little about them.

It started ten years ago. Ray and Kent Holtzclaw, his hunting partner, had hunted this area in the high desert of Northern California through the sixties and seventies. Only to have it go on a severely limited "drawing" in 1980. The chances of being drawn were one in twenty. It took us six years to draw it the first time, and

Continued on next page

we have just finished a hunt there last year to make it two times in the sixteen years it's been on a draw. We love that type of country so we decided that if we couldn't hunt it each year for deer, we would just go up in the summer and spend three days shooting. Hence the beginning of what would become known far and wide as the Skedaddle Long Rifle Championships. It started out shooting squirrels and jack rabbits. Then Ray's nephew Mike Boyle, known to his hunting partners as Piggy (for obvious reasons once you've spent a hunting season with him), found an empty gallon Carlo Rossi wine bottle that the shepherds had left out in the sagebrush. He filled it with water out of the spring and set it against a rock bluff about three hundred yards away. We all started fighting over who was going to get to shoot at it first. We finally decided to draw straws. And while we were at it, why not all throw a dollar in a hat and whoever hit the bottle won the pot. Well the battle was on. It didn't take long to bust the first bottle, so before you know it, we're all out hunting bottles instead of squirrels. Those shepherds must have been there a long time, or there must of been about one shepherd for every two sheep, because we found quite a few bottles with Carlo's smiling face on them. The next year we decided to make steel gongs and not rely solely on the drinking prowess of the shepherds. We had gongs at one, two, three, four, and five hundred yards. Everyone would draw straws for the shooting order. Then you would start shooting at the one hundred yard gong; if it was hit you would get one gong (or point) and the chance to shoot at the two hundred yard gong. This would continue until you missed, or you hit all the gongs. Anyone with the same amount of gongs for that relay would shoot a tie breaker. We have evolved each year, and this year it was our Tenth Annual. On Thursday August 17, Ray, Mike Dampier, Buck Price, his boys, and I set out for the desert so we could set up the course. It consisted of a 12" gong at two hundred yards (photo #2), a 12"gong at three hundred yards along with a Sinclair wind flag and the "egg box" (that's right, we have no shame, we stole the idea from the Hickory Egg Shoot people). At four hundred yards we have a gong and the first deer silhouette with gong attached (photo #3). At five hundred we have another wind flag, a gong and another deer with gong attached (photo #4), and at six hundred we have a 16" gong. The format has stayed pretty much the same since the Carlo Rossi days. We shoot from portable benches over a rest (The first year a card table and a balled up jacket. This year off benches of your choice with either a Witchta or Hart rest. Photo #5). You start at two hundred yards and keep progressing until you miss, or you hit the 600 yard gong. Ties at the end of the relay are broken with a shoot off, usually standing at 200 yards. (Editor: Presumably a "shoot-off" is different than a "shoot-out", although our writer is not totally clear on this...)

We have a three shot group to start the competition. Tightest group is worth three gongs, second tightest two, and third tightest one. Then four record relays are run on the course. The person with the most gongs at the end of the day is crowned the Skedaddle Long Rifle Champion for that year. We all chip in for grub, a hat for each participant, and "The White Hat" for that year's champion.

Each year we try to add a new twist to keep everyone interested. This year it was an egg shoot. No, not at 500 yards like you folks; we're starting out slow, our egg was at three hundred yards. It cost five bucks to get in, one shot at the egg, winner take all. It was the perfect ending to the day. We were running out of daylight because we got a very late start. I started cooking breakfast at 5 a.m. but we couldn't start shooting until 11 a.m. Why you ask? Well it was a stroke of scheduling genius on my part, but more on that later. The sun was low on the horizon as we all took our crack at the egg. We even had some antelope hunters drive up and ask to join in. All in all there were twenty five people who took a shot at the egg. The last guy to shoot was a friend of mine, named Jim Berti (we call him Birdie). He is fairly new to shooting, but he and our friend Chip (whose legal name is Mervyn Earl Arenchild III. Now is there anyone out there who wonders why he goes by "Chip"?) drive ten hours each way to attend Skedaddle each year. This year Birdie had some trouble, he hit the 12" gong at two hundred yards three times, but hit the three hundred gong only once all day. Birdie was the last shooter to try for the egg, hanging there untouched to this point. As the sun settled slowly behind Skedaddle Mountain, Birdie blew the egg into about a million pieces, to the instantaneous eruption of a standing ovation from the entire crowd (about thirty by then). The winnings from his tremendous display of marksmanship are being sent to Mr. Sinclair, for a cleaning setup of his very own. Next year's twist? We have all agreed that we will add one record relay that is not shot off the bench. It will consist of a shot at a 9" gong while leaning over a log and one shot sitting, at two hundred yards. Then one shot kneeling, and one standing, at a 9" gong at a hundred yards. Dave, can you recommend any good books to teach me the basics of building good High Power positions? It looks like I'll need it for next year. (Editor: We have several good Highpower books in our library here, but they are all strangely silent on this "leaning over a log" position. Possibly it is a new development in International Free Rifle shooting, which we must admit that we do not keep up with as closely as we should).

The reason for the late start was that I had the amazing foresight to schedule (unknowingly) the 1996 Skedaddle Long Rifle Championships on the opening day of antelope season. Some poor local drove up to our camp Friday, the night before the opener, and saw twenty plus guys in camp, all packing rifles, setting up portable benches, and a dozen spotting scopes. He meekly asked "Are you folks going to be here tomorrow?" I explained that "tomorrow" was the Tenth Annual Skedaddle Long Rifle Championships! Then he explained that it was also the opening of antelope season, and he had been scouting this one buck for three weeks. We spent from about 6 a.m. to 10 a.m. that Saturday morning watching him successfully stalk a nice buck antelope. He was just driving out from within our course when the game warden drove up in a cloud of dust. He took a casual look at the antelope, and then proceeded to ask us, with a certain amount of emotion, just what in the Sam Hill twenty of us were doing packing rifles around on the opening day of antelope season... when there were only fourteen permits issued for the whole area? He told us that the Fish and Game plane had flown over our camp, radioed him to "get right over there and find out what was going on, and don't spare the horses getting there". I gave him a greatly capsulated history of The Skedaddle Long Range Championships (I left out our plans for "leaning over a log" for next year, for instance). The gentleman was even, in the best tradition of the Hospitality of the West, invited to join us, if he so wished. Whereupon the worthy retired to his 4x4, and I caught snatches of his radio conversation with headquarters. I picked up a word here and there... "Nuts"... "But they seem

harmless". We were allowed to continue, and our Inspector left us with a growled admonition to "Stay out of trouble!" Who, us?

So I can hear all you ***PS*** subscribers already wondering which custom smithed rifle you'd take out of your vault to come over and show us country boys how to shoot. To date all of us have been using factory rifles. Magnums seem to do best. This year's winner Steve Harl, and second place Leo Cannon both shot 300 Winchester Mags. Steve's was a Ruger M77 straight out of the box, and Leo had a brand new Winchester synthetic with the BOSS system. Both shot hand loads, benchrest prep on the brass, except neck turning, and a 180 grain Nosler ballistic tip over some H4831. Buck Price, who tied for second, shot a left handed (no handicap to Buck because he sits on the wrong side of the rifle anyway) Remington 700 in 7mm Remington Magnum. I can hear the collective groan of your readership. It's not a rule that you have to shoot a factory rifle. It's just that until a couple of years ago we didn't know there was any other choice.

This winter Ray and I have started the first custom Skedaddle Long Rifle project (that we know of anyway). It is a 280 Improved. The basics have been derived from reading The Hunting Machine (***P.S.*** February '94, page 58) by John Feamster, The Quarter Mile Deer Rifle (***P.S.*** June '94, page 45) by Bob Jourdan, and .339 Deja Vu Part Deux (***P.S.*** October '95, page 67) by Jacob Gottfredson. We also received recommendations from Dan Dowling, and of course I've read some books, and I have a few screwball ideas of my own. Our formula goes something like this:

1. Take one Dan Lilja stainless steel blank in .284, 10 twist, contoured to his #4 contour.
2. Have the barrel sent to Dan Dowling about the same time he received a Remington action from you.
3. Have McMillan build you a Remington Classic, 20% gray swirl in a black stock, with a 1" Pachmayr decelerator pad installed on an inletted blank.
4. Dan trues the action. He pins a Tubb's recoil lug to it (his personal favorite among recoil lugs). Then chambers the fitted barrel to 280 R.C.B.S. Improved. Why R.C.B.S. Improved instead of the more popular Ackley? Pure science. I was afraid of the slight chance of a feeding problem in my vintage Model 700 action with a 40 degree shoulder, and I think the 30 degree shoulder of the R.C.B.S. is just prettier than the 40 degree of the Ackley. I also wanted a rifle that would perform at near magnum levels without the hassle of the belted case. Capable of firing a 140 grain bullet, 3000 feet a second or better at the muzzle, and still retain around 1500 foot pounds of energy out to around 500 yards. It also had to do this is in a 8.75 pound rifle with under 20 pounds of felt recoil. I think that this combination will do so, if my math is correct and I understand the recoil formula in the back of the Lyman's reloading manual.
5. Once Dan has finished the metal work I will pillar bed the action into the McMillan stock. Bed the Weaver two piece base to the action, lap the Millet rings, mount my Leupold 3.5 to 10 matte scope, and hopefully go kick some butt at the 1996 Skedaddle Long Rifle Championships.

Is this fair, Ray and I building custom rifles out of some of the best components, the metal work being done by a renowned benchrest gunsmith, in an attempt to win what is supposed to be a friendly competition? Of course not! That is precisely why it is such tremendous fun! Do you remember the look on the Grinch's face once he had come up with the idea that would keep Christmas from coming to Whoville? Well, planning and building these rifles has been that much fun, if not more. Besides, this whole thing started so we could learn the performance capabilities of our equipment in real life conditions. Now that we have a pretty good idea on our factory rifles let's see what one of the custom rigs will do.

After ten years of doing this, what is the biggest change I have seen? Well it is two fold. First would be our hand loading. We were just reloaders a few years ago. Now a few of us have been taking advantage of what the benchrest community has made available to the "reloading hunter" who has taken a keen interest in "hand loading" to improve his accuracy. The second, and probably more important, is the maintenance of our rifle's bore. Only a few years ago, even once we were deburring flash holes and the like, we were still just running a few wet patches of Hoppe's down the bore with our multi-jointed aluminum rods at the end of the day. At this year's shoot there were enough 44", one piece, coated, Dewey rods waving around that it looked like a fencing convention. If invaded by a foreign army, once our supply of ammunition (which was considerable) had been exhausted, we could have made one last valiant charge, Dewey rods held high with pierce style jags firmly attached, the glint of the hot desert sun flickering off the Shooters Choice soaked shafts. Reminiscent of Teddy Roosevelt, the Rough Riders and their charge at San Juan Hill.

Sound like fun, Dave? (The Skedaddle Long Rifle Championships, not the charge at San Juan Hill). If you so wish we'll make a reservation for you next summer!

Last year we were two guys trying to pound 1 MOA out of light factory rifles, and twelve short months later we're a couple of guys who have two different projects going with three different wildcat chamberings. Have I bit off more than I can chew? Probably. Has the learning curve been steep? Yes, and I can't even see the top yet. Will I make some mistakes? Definitely. But with the help and cooperation of people like Jim Guedmin over in Eureka, CA, Larry Smart in Union, MO, and Dan Dowling in Palisade, CO, it has been a very pleasant journey so far. They can't imagine how much I appreciate their patience and consideration.

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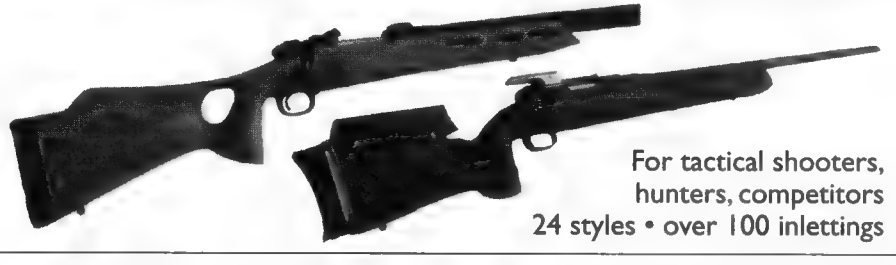
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RETURN TO THE...

Continued

Well I've been rambling on for some time now. Hope this has been some interest to you, and hopefully your readers. I will write again, once we have received our rifle projects, and have them up and running.

Best wishes,
Joe Cerami
10582 French Creek Road
Palo Cedro, CA 96073

(Addendum, from a recent letter to the editor, from the good Mr. Cerami...

We have received our Dowling/Cerami 280 R.C.B.S. Improveds and have been doing some load testing. Looks very promising. A word of advice; don't get within five grains of a load mentioned in P.O. Ackley's book! After buying a couple of books on wildcats with no mention of the 280 Improved, we started to work up to the suggestions in his book. Ackley suggested load of 63 grains of 4350, with a 140 grain bullet, this load would be *waaaaay* too hot for my rifle. In fact the closest we got to it was 61 grains, and only once. God bless Kenny Jerrett. If only his article had been in the March issue instead of the April issue it would have saved me quite a bit of floundering around, and at least a couple of good scares. His load info has been most helpful. Well I plan to write you in detail about the development and load testing on this rifle after it competes at Skedaddle this year.)

PHOTO#1 The members of the Inter-mountain Benchrest Society or I.B.S. for short. The I.B.S., kind of has a ring to it, don't you think Dave? Members left to right Ray Browning, Nick Cerami, and me.

PHOTO#2 Gong and stand at 200 yards. The chain has been the best design so far.

PHOTO#3 Buck Price inspecting the 400 yard deer silhouette.

PHOTO#4 A Sinclair wind flag, deer target, and a solo gong at 500 yards. You have to hit the solo gong before you get a crack at the deer gong. You don't win anything if you hit the wind flag except the opportunity to give me thirty bucks.

PHOTO#5 Steve Harl, this years champion, explaining the finer points of shooting, to his boyhood friend Max Laughlin. Both under Shooters Canopy.

PHOTO#6 At just before sun up, Max Laughlin, (head of Gong Construction), models the luxury suites at Skedaddle.

PHOTO#7 The standard package at Skedaddle. Tarp only, no cots. Mike Dampier looks on as Fennel tries to insert his foot into his boot without stomping Clifford to death.

PHOTO#8 The Chuck Wagon with the borrowed mascot (The Duke) of the Eureka Bozo's looking on.

PHOTO#9 Steve Harl taking his turn spotting for Ray squirrel hunting in the alfalfa fields.

PHOTO#10 Ray and I thinning the squirrel population. We set up in this same spot three Saturdays in a row and shot all day without moving. I sure hope the squirrels don't befall the same fate as the prairie dog.

Continued on next page

PHOTO#11 Nick Cerami, taking his turn at the bench. He's not much threat to the squirrels yet, but just wait until he can wink unaided.

PHOTO#12 The phony benchrest rifle. I sure catch hell over "Old Whitey" until we start shooting.

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WORKING WITH DUPLEX LOADS

by

M.L. McPherson

Synopsis: Long before chemists found ways to mitigate nitrocellulose's burning rate, so they could adapt it for use as a gunpowder, shooters found a way to use various forms of energetic cellulose ***with*** *black powder. Addition of a few percentages (of the black powder charge weight) of such material between the primer and the main charge dramatically improves black powder's burning — this practice can reduce fouling by an order-of-magnitude.* ***Unique*** *has long been the powder of choice for duplex loadings. Use of a small charge of such a compressible powder, no doubt, offers other potential benefits. However, recent testing suggests that, depending upon one's goal, other powders might deliver better results.*

In preparation for anticipated participation in a long-range black-powder competition next summer, I set about to see if I could learn a bit about duplex loadings. Partly for historical reasons, I suspect, many such competitions allow duplex loads in long-range events. After all, ever since the invention of celluloid and other forms of energetic cellulose, shooters have been cutting the stuff into little pieces and inserting those into the bottom of a cartridge case before pouring in a charge of black powder — this is certainly nothing new!

I wanted to compare several types and burning speeds of smokeless powder to see how those might stack up with regard to fouling reduction and ammunition uniformity. I tested duplex loads using five smokeless powders: Scott-1000, Nitro-100, AA #2, AA #5, XMP-5744. I also tested standard (singlex?) loads using GOEX's FFg and Cartridge Grade powders. Each powder used in this testing came from one fresh can of that type.

Cases were match-prepped (everything a bench rest shooter does to any case save neck turning) once-fired 186 grain (+/- 0.5 grain) R-P. I used Federal 150 (Standard Large Pistol) primers, seated to slightly crush the pellet. Bullets were weight-selected 406.5 grain to 409.5 grain (nominal 405 grain) commercial-cast by Lane Bullets (now out of business, retired). These Lane bullets feature a proper black-powder lubricant, a characteristic few commercial-cast bullets share.

For this testing, I sorted and used the lightest bullets from one box of 500. I had no delusions that I could include an accuracy study with this all-day-long velocity and fouling study — with a helper, maybe; by myself, no way! In any case, I would probably not use bargain-priced commercial-cast bullets for competition. Nevertheless, I figured I might as well use this opportunity to cull lighter bullets from this box — typically heavier cast bullets are better balanced, therefore, more accurate.

I loaded this ammunition on an RCBS Rockchucker press using RCBS dies. To lubricate the case mouths for bell-mouthing and expanding I used NECO's handy neck lube kit, which uniformly applies a thin moly-disulfide coating to the case necks. Cartridge overall length (OAL) was 2.658". (These loads will not function through an unaltered New-Model-1895 Marlin — too-long.) Case mouths were heavily roll-crimped into the front of the properly designed crimping groove.

I carefully weighed all powder charges and uniformly dumped those into cases using the swirl-charging technique I have previously discussed in the pages of ***PS***. (Slowly pour the charge from a powder pan and against the mid-point of the side of the funnel's cone.) I used MTM's funnel with the long drop tube extension. (Since it has a smaller orifice, I believe Forster's similar Blue-Ribbon funnel might do a better job but it does not properly fit 45-70 cases!)

There were many ways I could have begun this ongoing study, too many! I decided to keep things simple, always a good idea. I first measured the usable black powder capacity of a normally-resized and prepped case, with the Lane bullet seated to normal OAL (2.658"). As it worked out, seating that bullet normally on 65 grains of GOEX FFg, installed using the aforementioned swirl-charging technique, would just slightly compress the powder charge — just what I wanted and an easily remembered charge weight.

To keep things simple, I used five grains of smokeless powder for all duplex loads, regardless of smokeless powder type. I also decided to adjust the black powder charge according to the density of the duplexing smokeless powder. I choose to reduce the black powder charge sufficiently to accommodate only one-half the usable case volume consumed by the smokeless powder charge. I wanted all smokeless charges compressed a uniform volume percentage, i.e., seating the bullet would compress the smokeless charge to one-half its free volume — unless the black powder also compressed, which it, no doubt, did. My purpose was to try to achieve reasonably similar loaded-round black powder charge densities, which this procedure should theoretically have done.

If this is still not clear (I know I have confused myself!) note the table. Black powder charge reduction was greatest with smokeless powders of lowest bulk density. Also, this reduction always left the top of the powder column higher in the case than the top of a 65 grain FFg column would have been.

Since my intention was to try to measure two things at the same time (fouling level and ballistic uniformity), I had to make several compromises. I choose to swab the bore after each shot using a jag, with a patch soaked in 70% isopropyl alcohol (rubbing alcohol). I stroked this patch full length of the bore twice (from the muzzle end). I followed that patch with a clean dry patch to dry the bore and observe fouling residue, for comparison purposes.

Choosing this protocol proved to have been a good decision. I could clearly observe, in real time, that some combinations were dramatically cleaner burning than others. I could also do that without fouling-up (all puns are always intended) my ballistic uniformity study. Conversely, I could have shot extended shot strings without any cleaning to see how much the cumulative fouling affected uniformity — a path not taken.

Observation of smoke generation was problematical. Winds were gusting and otherwise variable. However, it seemed that combinations showing less fouling on the per-shot patches and in the spent cases also produced less smoke. This is a judgment that would be hard to quantify more closely. I did note that all duplex loads (particularly those using the faster-burning powders) generated a much

Continued on next page

WORKING WITH DUPLEX LOADS

Continued

smaller muzzle fireball and eliminated expelled burning cinders. In my 22" barreled Marlin Model-1895, standard black powder loads produced a monumental muzzle fireball with visible burning cinders sometime traveling past the chronograph (15' to the center screen).

Examination of per-shot patches and spent cases revealed something quite interesting. (Since combusting nitroglycerin is an effective oxygen scavenger I should have anticipated this effect, but, alas, I did not.) Scott-1000 and Nitro-100 are very similar shotshell powders. Typically these burn at essentially identical rates and are similar in bulk density and compressibility. However, Nitro-100 contains 27% nitroglycerin, while Scott-1000 is essentially pure nitrocellulose. Since, as noted, reacting nitroglycerin is a strong oxygen scavenger (that is why hell-fighters use it to quench oil-well fires), it seems reasonable that it might rob sufficient oxygen from the potassium nitrate in the black powder mixture to leave more unburned powder residue behind, compared to a pure nitrocellulose powder. That is precisely what I observed. Duplex loads using Scott-1000, the only single-base smokeless powder tested, were far and away the cleanest. Cases from these loads were visually indistinguishable from smokeless powder load cases!

However, fouling reduction is not the only criterion! Maximizing ballistic uniformity was also a concern. To this end, I chose to fire and chronograph fifteen rounds of each type of load in one string. Rather than try to analyze the results in this discussion I will refer the reader to the included tables. Note that "clean-burning" did not equate to "consistent." Also note the mean velocity column. . . .

Mean velocity results of this study completely baffle me. I can understand that a very fast powder might generate less velocity owing to the "boiler room" effect, i.e., the smokeless burns so fast that it shoves the bullet out of the case before the black powder explosion has significantly progressed. Since, in that situation, there would be more "boiler room," the result would be a reduction in peak pressure and velocity. Conversely, a slower smokeless powder might not begin to burn and generate sufficient pressure to move the bullet until after the black powder was sufficiently involved. In that situation, there would be more initial pressure and, therefore, more velocity.

However, considering the above argument, how then does one explain my results with AA #5 (a powder in the middle of the burning rate spectrum of those tested)? Here we see generation of a whopping 9% more energy compared to the next-closest candidate, 19% more than the least energetic loading. (All loads used essentially the same charge of black powder and only an 8% adjunct of smokeless.) There is evidently something going on here that evades my understanding — nothing unique in that!

In the singlex black powder comparisons, I also included a five-shot string starting with a fouled barrel and without any cleaning. In this application, GOEX Cartridge Grade powder is slower than GOEX FFg, which I expected — GOEX rates this powder as intermediate between Fg and FFg. However, Cartridge Grade also generated vastly more fouling, a result I was not prepared for — it is **supposed** to be much cleaner. I noted significantly more fouling on the per-shot patches. On cleaning the bore with alcohol patches after firing the final five shots (without swabbing between shots), Cartridge Grade required eleven patches before I got a "clean sweep." Standard FFg required only seven.

In defense of Cartridge Grade, almost certainly this powder would have performed better if I had been shooting either heavier bullets or a heavier charge. It is also possible this product works better with more powder compression. It is not unusual for black powder cartridge shooters to apply significant powder compression in their loads. Here I was using essentially none.

The associated tables bear out another point I cannot leave unmentioned. For those out there who **just know** that black powder cannot generate truly consistent loads, I have a challenge: I want you to take your trusty 45-70 and find any smokeless powder load duplicating black powder pressure and generating less than ten fps standard deviation. You are welcome to try jacketed or cast bullets, but to be fair you should use only culled (light) commercial cast bullets — just like I did. Good luck. Then when you have done that, realize that the best black powder available in days gone by (Curtis & Harvey Diamond Grade) was **significantly** better than anything we have today, owing in part to a unique charcoal root stock. Further, and I am just guessing here, but I suspect that with a bit of charge-weight tinkering I might shrink the standard deviation of the FFg load reported here just a mite — remember, this was my first try, I might be lucky (but not that lucky!)

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45-70: 1895 Marlin, 22" Barrel. Various loads: 405 grain commercial cast bullet, Fed-150 (Large Pistol Standard) Primer. (See text for details of loading techniques.) Data based on 15 shot groups. Instrumental velocity at 15' (Oehler 35P). All duplexing charges, 5.0 grains.

Duplexing Powder	GOEX Charge (grains)	Maximum fps	Minimum fps	Extreme Spread fps	Mean fps	Standard Deviation fps	Relative Fouling (1-10)
Scott-1000	59.9 FFg	1265	1226	39	1249	11	1
Nitro-100	60.3 FFg	1259	1224	35	1243	9	4
AA #2	61.5 FFg	1289	1252	37	1272	10	3
AA #5	62.5 FFg	1368	1342	26	1356	8	2
XMP-5744	62.0 FFg	1308	1285	23	1296	6.5	4
None	65.0 FFg	1214	1194	20	1204	6.2	8
None	65.0 Ctg.	1152	1117	35	1136	12	10

GOEX FFg & Cartridge Grade: Five-shots starting with fouled bore, no cleaning.

GOEX Powder	Charge (grains)	Maximum fps	Minimum fps	Extreme Spread fps	Mean fps	Standard Deviation fps	Relative Fouling (1-10)
FFg	65.0	1213	1191	22	1205	9	7
Cartridge	65.0	1138	1119	19	1131	8	10

Considering these results, as a first guess, if my goal was minimization of fouling, I would use about 10% of the nominal charge weight of **Scott-1000** (or a similar single-base powder). Conversely, if my goal was a combination of fouling reduction and minimized standard deviation, I would use about 10% of the nominal charge weight of **XMP-5744**, or a similar burning rate powder — perhaps an even better choice might be **SR-4759**, since this powder is similar in burning rate to **XMP-5744** and is both more compressible and single-based. Another study, another day. . . .

One final thought, regarding the "Boiler-room Effect." Many advocate using only the hottest Magnum Rifles primers for all black powder rifle loads — evidently theorizing that, "More is better." I believe this study (where I used a mild pistol primer) might very well suggest just the opposite: "Less is better." My theory: When one uses a milder primer, the powder begins to explode with less prior bullet movement; less disruption to the boiler-room equates to a more consistent boiler-room from one shot to the next. Therein lies a lesson for all handloaders: For consistent loads, minimize primer-blast-induced bullet movement.

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MASTER CHRONY

REMOTE BENCH READOUT IS CONVENIENT INNOVATION

by

Jack Rush

SHOOTING CHRONY, of Mississauga, Ontario, Canada has been providing the shooting world with a variety of chronographs for several years. These machines have ranged in complexity from simple and inexpensive units with no memory to sophisticated units with the capability of remembering as many as a thousand shots, accompanied by download capabilities into an IBM PC and augmented by a ballistics program.

The primary advantages associated with Shooting Chrony products have been light weight self contained units, providing dependability and accuracy at a reasonable cost.

Three out of four of the chronographs that I have used extensively over the last few years have been SHOOTING CHRONYS and my level of satisfaction has been quite high.

The new MASTER MODEL Beta and Gamma Chronys now have the readout and control conveniently at your fingertips.

I have run a number of comparative tests on chronographs over the years, finding no significant difference in results between models or brands. The compact size and weight, and quick setup nearly always motivate me to grab a CHRONY on the way to the range. I carry the chronograph and accessories in a padded pistol box, though they come as a self contained small unit. Set up time is less than one minute, not including line up with the rifle.

Choice among the various models of SHOOTING CHRONY depends on the level and quantity of information you wish to accumulate. Both the Beta and Gamma provide information including high, low and average velocity, and most important, standard deviation. They also retain and will play back each individual shot.While I have a GAMMA model that holds a thousand shots, I seem to gravitate toward the BETA, which has a 60 shot capacity, factory defaulted into strings of ten. String size can be modified to suit your needs. The Beta also has the capability of working with an IBM, set up for the ballistics program, if desired. The ballistics program and PC interface are included in the package with the GAMMA, but is an add on feature for the BETA.

I recently procured the latest feature, the MASTER model, which places the readout and control on the bench, near the shooter.

Both the GAMMA and BETA originally came with the LCD readout face attached to the front of the chronograph. An optional 15 foot remote control cable made operation of these units very convenient and are a necessity, in my opinion, for comfortable operation.

The single problem that I had with these units was being able to read the LCD at 15 feet, the best distance for placing the unit with rifles of any substantial muzzle blast. While the readout was of generous size, my vision is less than perfect, and light reflection often made it impossible to read numbers without getting up from the bench and walking a bit closer, remote unit in hand.

The new MASTER models are the answer. The MASTER Gamma and Beta Chrony attach the LCD readout to a common telephone cable. The readout is placed beside you on the shooting bench, and includes the remote control on its face.

My new MASTER unit is the Beta, with 60 shot, six string capacity. As I am so close to range facilities I seldom have need for the large memory capacity of the GAMMA, though it, too, is available in this MASTER configuration.

If the convenience of the control and readout on the bench in a package not much larger than a deck of cards were not enough, you can place all your data in permanent memory, detach the readout unit and stick it in your shirt pocket. When you get home, you may attach a nine volt battery to a little pigtail wire,

Continued on next page

The Beta Master Shooting Chrony, all components set up and shown.

The self contained Shooting Chrony unit, sans diffusers.

MASTER CHRONY

Continued

plug it into the readout unit, and perform any function of data recall and computer analysis that previously required the entire unit.

Accompanying photos show my setup for comparing data. In this photo I have placed an Oehler 33 unit in the middle, with one of the SHOOTING CHRONY units at either end. I can tell you that getting six photo cells all lined up with each other and the bullet path is something of a nightmare. Also, they must all be set up to provide a fair and equal playing field. For instance on clear, bright, days it is necessary to use light diffusers over all photocells. If they operate at all under a clear sky, the units without light diffusers will show greater variability than the units with, regardless of brand or model. Windless, bright CLOUDY days are ideal for the operation of any of these photocell chronographs.

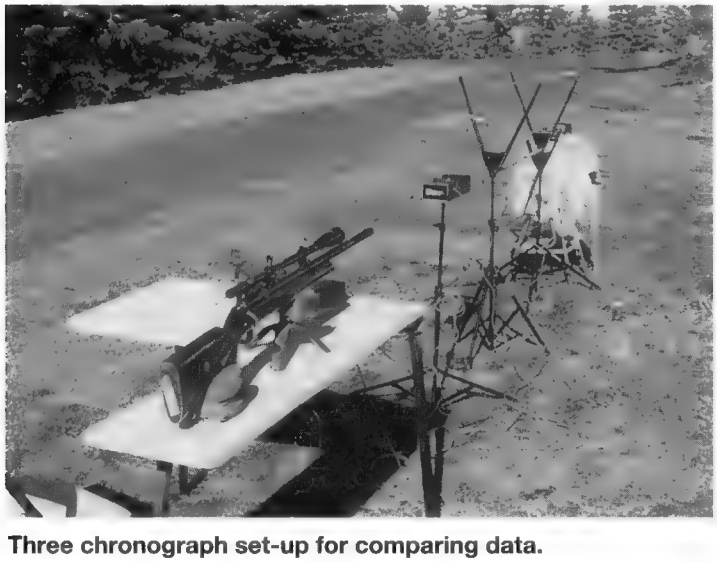
To give the reader an idea of the type of comparative studies I have done, I ran the three chronograph setup under a clear sky, using the 22 rush and 22 rimfire. I hooded the GAMMA (used light diffusers) and the OEHLER 33, left the BETA open to the sky. The difference between the hooded GAMMA and OEHLER was six feet per second in a ten shot string with the 22 rush, being 1853 fps and 1847fps. Using the 22 rimfire, the respective velocities of the OEHLER and the GAMMA were 1225 and 1233 average velocity. These differences commonly run around a half of one percent.

The open unit was more erratic.While changing the diffuser from the GAMMA unit to the BETA, a difference in light angle and intensity also occurred. Changing light conditions make comparisons in different time frames invalid. All three units responded perfectly under a lower sun angle: for a ten shot string, the OEHLER giving an average of 1240 fps, the hooded GAMMA 1260 and the unhooded BETA 1253. The standard deviation for the OEHLER and the BETA units were both 15, the open topped GAMMA recording a SD of 19, again illustrating the greater variability of undiffused operation under clear sky. The 20 feet per second difference was somewhat larger than usually encountered, but extreme wind prevailed. As you are operating in micro seconds, a shaking chronograph photo sensor will always give less reliable results than one operated under ideal conditions.

These results are generally consistent with past experiments along this line, higher velocities usually resulting in greater

Beta Master Shooting Chrony, as I prefer to transport it.

This is all you need to do complete recall and computer work.



Three chronograph set-up for comparing data.

Controls for the three chrony set-up on the shooting bench.

variation in numbers, but staying within the same general percentage variations, typically about a half percent between individual units.

Any electronic instrument is affected by temperature, but I have not encountered any difficulties along this line. I have operated the Beta Master unit at freezing. I found that failure is likely to occur due to low battery at freezing temperatures, but that the unit itself will operate normally when a fresh battery is used. Low temperature is more likely to affect a weakening battery than the chronograph itself.

In general, comparative data shows the little SHOOTING CHRONY units to be quite reliable and dependable when, as with any chronograph, operated according to instructions for varying conditions.

CHRONYS operate on only two control buttons, performing the simplest and most complex advanced functions by combinations of manipulation of these buttons. As with any electronic device, the functions of the controls are not self explanatory, but are quickly learned in a step by step manner easily understood in a soon to be published new manual. The current manual is also quite clear and very complete, if perhaps somewhat less oriented to teaching and more technical in nature.

Just as I thought that with the remote cable and then the "on bench" readout I had reached the height of chronograph happiness, I am told that SHOOTING CHRONY is planning an inexpensive add on printer, operating either from the remote cable of the regular GAMMA or BETA or the LCD readout on the MASTER models. This, too, will reside on the shooting bench. It is planned to be available by late spring of 1997.Accessories for an increased shooting area of 14.5 X 14.5 in the usual inverted truncated triangle shape will soon be available. This will be an advantage for all shooting, but especially for shotgun and bow.

An advantage of the SHOOTING CHRONY system is that the latest innovations are usually compatible with existing units.

For owners of older, simpler machines, the factory allows trade-ins on newer, more complex models.

For complete information on the entire line, contact Shooting Chrony, 3269 Niagara Falls Blvd., North Tonawanda NY, 14120, or call 1-905-276-6292.

FIRE LAPPING A KRAG AND A SPRINGFIELD

by

T.L. Lenzi

Dear Dave:

I have just completed pressure firelapping my second rifle, a 1903 Springfield .30-06, serial #600xxx, with a barrel date of 6-17. I couldn't be more pleased with the results.

The first rifle I firelapped was an 1898 .30-40 Krag military rifle. The rifle was in fine condition but had a dark bore. Using jacketed bullets, groups of 1¼" at 100 yards were possible, but that dark bore bothered me.

I contacted the NECO Company of Emeryville, California. They recommended slugging the bore to find its diameter and to detect any tight or loose spots. What an eye opener this was! By using two cleaning rods and a soft lead slug, tapping the slug between the rods to maintain tightness in the bore, one can get a feel of the interior dimensions of that particular tube.

Starting from the breech, the slug was a tight fit for about 6", then it actually dropped through the bore to a point 18" from the muzzle, where it tightened up again all the way out. This was most disturbing! I made a quick call to NECO, they explained that this was quite normal with early twentieth century military firearms. Due to the highly erosive powders of the day, the heat and pressure reached its peak about 6" to 8" in front of the chamber, then gradually decreased as the bullet made its way to the muzzle. It is not at all uncommon to find this looseness in these early arms.

Slugging at the breech and muzzle gave a bore diameter of .3100". I obtained from NECO one of their Pressure or Fire Lapping Kits, consisting of laboratory grade abrasives in 220, 400, 800, and 1200 grits. NECO states that there is enough abrasive in the kit to properly lap ten to twelve firearms; I personally feel that this is a very conservative figure. The very small amount that was used for lapping both rifles leads me to believe that many more firearms than this can be treated.

I used two glass plates for embedding abrasive into the bullet bearing surface. The bullets were cast of a 20-1 lead-tin alloy, sized .003" over groove diameter, lubed and gas checked. The reason for the oversized bullets was to be certain of tight bore contact during the lapping process.

A small amount of the 220 grit was placed on one plate and the bullet rolled several times between the plates. Excess abrasive was wiped off after charging. Care was taken to thoroughly clean the plates before using the next grade of abrasive.

Ten 220 grit-charged bullets were seated over 5 grains of UNIQUE, the bullet ogive just touching the rifling leade. Going to the 400 grit, 15 were loaded over a 6 grain charge. For the 800 grit, 25 were loaded with 8 grains, and finally, for the 1200 polishing grade, I loaded 35 over 10 grains.

I reasoned that by increasing the velocity with the finer grades of abrasive, a better polish could be obtained, just as increasing the RPM of a lathe and the use of increasingly-finer grades of emery results in a finer surface.

I really didn't want to run that coarse 220 grit through the bore, but the excellent instructions supplied with the kit assured me no harm would be done. It is actually necessary to start with the coarse grades in order to remove the tight spots instead of merely polishing over these areas.

At the range I made sure the bore was clean and ran an oiled patch through the bore prior to firing.

After the ten 220 grit loads were fired, the bore was very carefully cleaned to remove all traces of abrasive. Care was taken to thoroughly clean the chamber as well. For cleaning, I used a hard stainless steel rod as I didn't want to take a chance on embedding grit in my coated rods.

After passing an oiled patch through, the 15-400 grit loads were fired. This was repeated until all the lapping loads were fired, being careful to thoroughly clean and oil the bore between firing the various abrasive grades.

I had set up targets at 50 yards to record any changes in accuracy. Groups

Continued on next page

FIRE LAPPING A KRAG AND A SPRINGFIELD

Continued

with the 220 grit ewer 4". The 400 grit went into about 2", and the 800 and 1200 grits were one ragged hole around 1". This with bullets that were lubed for all practical purposes with abrasive grit. I couldn't wait to see how it would shoot with "real" bullets!

The bore gleamed like a new dime! Not just the lands, but even the very corners of the grooves.

Now when I slugged the bore, starting from the breech, a very hard steady push on the soft groove diameter slug moved it up the bore within 6" from the muzzle, at which point a small rawhide mallet was needed to lightly tap it out of the bore.

In my mind's eye, it was as if I were pushing a very tight slug through a long, smooth, very slightly tapered hole to a point 6" from the muzzle where I could no longer move it by hand pressure alone.

Slugging the breech and muzzle revealed both to be .3105" diameter. That taper must be very slight indeed; at any rate, I cannot measure it using a .0001" Starrett micrometer.

The 1903 Springfield would group no better than 1-1/2" at 50 yards using jacketed handloads. The bore was bright but I couldn't get any accuracy. I decided to firelap the bore.

Slugging revealed a bore diameter at the breech of .3089". bore diameter at the muzzle was .3085". There were no tight or loose spots.

Using the same technique and loads as for the Krag, I completed the firelapping process. The bore now shined like a mirror, held to the sky and viewed from the breech, the bore was dazzling!

Slugging gives a bore diameter at the breech of .3093" and at the muzzle, .3092".

The old rifle masters like POPE and ZISCHANG used to employ choke boring in their precise lead-bullet schuetzen rifles. This was an unexpected bonus. The only explanation I have for this is that the bullet wears ever so slightly on its way to the muzzle, thus reducing the cutting action.

Using Ideal #311413 cast of range lead with enough 50-50 solder added to improve castability, this bullet weighs in at 170 grains and is fairly soft. With an annealed Hornady gas check installed, and using my #4 lube seated so it is just grazed by the lands, both rifles will group within 1 MOA at 100 yards using an appropriate charge of IMR 4227.

Now I cannot duplicate this performance every time due to the military sights, but this is my fault, not the rifle's.

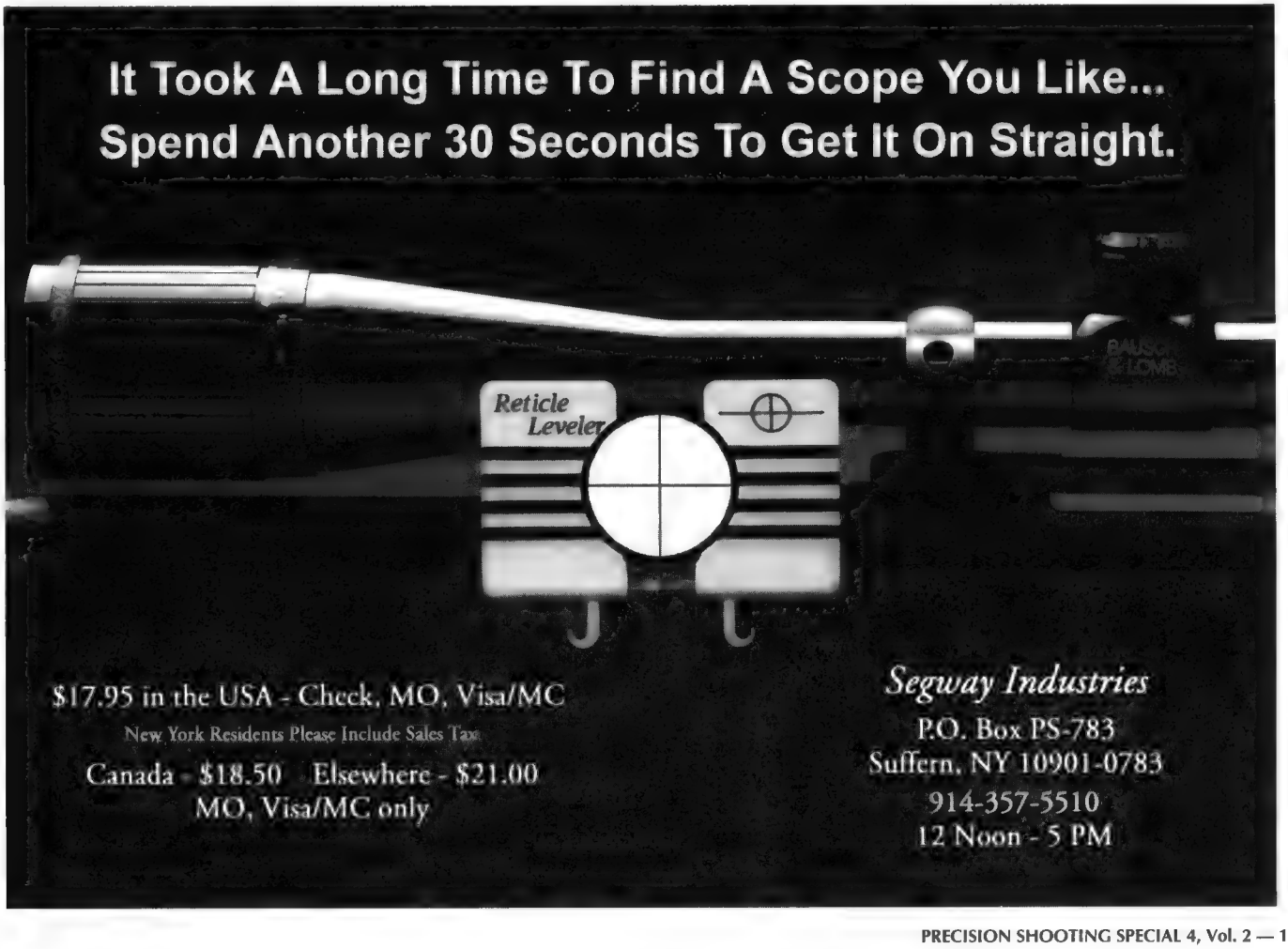
Because of their oversize bore diameters, and the fact that I am a lead-bullet fanatic, I will only use cast bullets in these rifles. That I can precision-fit a cast bullet to the throat and groove diameters no doubt is the reason for their fine accuracy.

Lest anyone would think themselves out of luck because they are not bullet caster, firelapping can be done using jacketed bullets.

The NECO company sells several different kits, from the basic abrasives to pre-embedded bullets. They even have one for the .22 rimfire.

For those willing to invest the time and care necessary to correctly complete the firelapping process, the rewards will be and improvement in bore quality, easier cleaning, and most important of all, accuracy enhancement.

T.L. Lenzi
9036 Graytrax Road
Grand Blanc, MI 48439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MORE NEW ZEALAND HIGHPOWER

by

Kim Williams

Dear Dave,

Now, it lacks a couple of years to the Millennium, but for those who shot the New Zealand Championships at Trentham this year, it was pretty close. New Zealand has abandoned the NATO 144 grain projectile and gone to the 155 grain Sierra and the wind at Trentham was almost non-existent. Normally, and well described by the Palma Team 1995, this means 4 to 5 minutes more (usually more) variation each side of zero,

"Blow, blow thou flaming wind,
But for Pete's sake make up thy flaming mind,
(Graffiti dated 1961 in Onslow Rifle Club),

but not in 1996. Wind conditions varied from dead calm, to mild breezes for the main series of matches. Remember that this is all "slow fire prone", 10 shots at 3/5/6/8/900 yards. With other matches and team shoots you need about 300 rounds. If you want to win the Queens Prize, it is iron sights only, scope sights if you enter Free Rifle. The modified rules now allow projectile weights up to 71 gr. in 5.56mm, 174 gr. in .303 British and 155 gr. in 7.62mm NATO.

Scores were incredibly high compared to previous years, mainly due to the mild conditions and the use of match projectiles for the first time in open competition. The lowest score to qualify for the Queens 50 was 491/500, the same as the top qualifying score last year.

There has been a fair amount of debate within the NZ shooting fraternity about the use of anything other than the NATO 144 grain projectile. A referendum of all NZ NRA members had to be held to decide if the 155 Sierra would be allowed. One major pitfall was the large investment of members in tight (.298 X .306/.3065) barrels needed to shoot the .307/.3075 NATO projectiles, not to mention the large stock of NATO factory ammunition and projectiles held by the shooters. I am glad to report that the urge of most shooters to improve their scores (and blow the centres out of the targets) overcame mere economic considerations. By the way, if anyone wants about 1500 NATO 144 gr. projectiles, please give me a call.

Most shooters reported no problems with barrel dimensions .002 inches or more under the Sierra projectiles, but as you might imagine, with the stocks of NATO ammunition, Mexican Match was a popular choice. West German MEN (Berdan primed) was the most available factory round.

This had a 144 gr. NATO projectile exiting a 30" barrel at 3020 fps. Most people chose to download the ball powder load by 1.5 gr. to give 2920 fps for a 155 gr. Sierra from a 30" barrel. My own variation was developed after reading the comments by Merrill Martin in PS, that in his early days of shooting, virgin military cases gave him very good results. I use a MEN case, remove the issue ball powder and 144 gr. projectile, chamfer the inside neck to remove the crimp, put in an appropriate load of 2208 and a 155 Sierra. No, I do not remove the inside neck coating of bitumen based paint. My groups without the paint were much bigger than with it left in (more consistent neck tension?). I just have to clean more often to remove paint debris.

A real boost to many shooters was in getting high grade scores. Walking up and down the firing line, the scoreboards were showing clean targets with high V bull counts and large smiles from the shooters manning the boards. The hard luck story was a member of the visiting UK London and Middlesex Rifle Club, who finished 495/500 after placing a V bull on the next door target on his next to last shot. I was watching him shoot and (in contrast to the rest of humanity) he didn't even seem to twitch as his target was awarded a zero. His club team awarded him both a very large wrong target medallion and a considerable bar tab for his error.

With NATO 144 grain projectiles, there had been a fair amount of hit-and-miss in grouping capability and at Trentham the wind was usually unforgiving. Errors in technique and reloading has been masked, but with match projectiles in almost calm conditions, many lower graded shooters made life really hard for the top rated group as well as the grading committee.

Part of the problem lay with the scoring ring dimensions. Creighton Audette noted that Commonwealth target dimensions reflect the grouping capacity of NATO ammunition and match projectiles group well inside that. The high scores were still able to be sorted out by V bull count and it still needs a fair bit of a trial to see if we have a problem with these high scores on our targets.

I normally have a nightmare of going to Trentham and waking up in a room full of snorers. A dream that turned out to be awfully true in 1995 and so awful in 1996 that I abandoned the bunkroom in the Provincial Rifle Club after the first night and settled down in a corner of the bar for the next week. The general atmosphere of the bar was more conducive to sleep than the bunkroom (at least after the bar had closed).

Numbers were down from 475 in 1995 (Palma year) to 252. In contrast to the large USA contingent of last year, the Palma Team and the Independents, we had 3 from the USA (actually, 2 from the USA, Tom Graham and Roger Culbertson; Roy Cole is actually from Texas, and Bill Tabor of the 1995 USA Palma Team was there for his 17th NZ Championships, so we tend to think of him as a Kiwi). Roger Culbertson had bad luck, his return flight timing clashed with the Queens Final 50, in which he had qualified to shoot and thus received the No 50 badge for a score of zero.

Roy Cole of the Fort Worth Rifle Club introduced my own club (Cheltenham Rifle Club) and a few other NZ clubs to the SR-42 target Postal Shoot and the trophy donated by ***PS*** in memory of Creighton Audette. Every time you bought him a beer, he pulled out more targets for NZ clubs to shoot on. *(Editor: Mr. Cole gave us our choice... pay for the Creighton Audette trophy, or the New Zealand beer bill. We really dodged the bullet there!)*

Well, back to the Championship. In the June 1995 ***PS***, Dennis Flaharty predicted that Graham Ballinger would one day win the Ballinger Belt and the NZ Championship. Dennis was right on the money, as Graham cleaned every shoot but for the last round of the last match (shot in one of the rare patches of tricky wind) to qualify for the Queens 50. The groan from the crowd of onlookers as a four was marked for the last round for a total of 499/500 was pretty loud, but there was no mistake in the Queens Final. Graham and Bill Tabor were the top two

Continued on next page

MORE NEW ZEALAND HIGHPOWER

Continued

qualifiers, but Graham cleaned the target to repeat his father's win of 20 years ago.

In stark contrast to the calm/gentle breezes of the main shoot, the Queens Final started in rain and wind. Although qualifying 10th on 496/500, I finished badly, putting 3 shots left and right of the bull to finish 19th. To add insult to injury, the rain and wind died out as soon as I had finished. Ah well, there's always next year, more practice and even more practice if I ever want to win the Queens Prize and sit in the chair (No, not the electric chair, although I am told the effect on your wallet is similar if you win).

We look forward to seeing more shooters make the trek out to New Zealand for our Championships. We were most happy to see in ***PS*** that the Palma Team and the Independents had good memories of the 1995 Championship. As well as trying international competition for the NZ Queens Prize (open to anybody) with match projectiles, our summer is in full swing when the New England States are in blizzard season and even California has grey skies.

Kim Williams
67 Lincoln Road
Wanganui
New Zealand

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ASK DERRICK

By

Derrick Martin and Barrett Tillman

Dear Derrick,

Over the last two years there have been several articles concerning the emergence of the AR-15/M-16 in service rifle competition. Not bad for a rifle that was bought for the Air Force chief of staff, who used it to shoot watermelons!

My M-1A has the potential to be a half-minute of angle rifle, but do I have the ability to use the potential? At least the person who built the rifle said it had the potential to shoot half-minute, and I cannot prove that he is correct with my ability.

I read that the typical .223 match load for 200 and 300 yds employs a 69-gr Sierra HPBT Match King at 2,900 fps muzzle velocity. In reading Sierra's fourth edition manual, the accuracy load for the 69-gr HPBT is 2,700 fps with top velocity being 2,800. Other than covering their backsides, there must be a reason that Sierra tables cut off at 2,800. There may be a safe combination of components that lets one arrive at 2,900 or you would not see this information listed or people using the load.

I was at a match, firing the offhand stage using an AR-15 when, after several shots, there was a jam. I ceased firing and cleared the rifle. The jam was caused by a spent primer that would not allow the bolt to close. When I examined the case, I found the primer pocket to be egg shaped. The load was just under the maximum listed in Sierra's third edition for a 69-gr HPBT with 748 powder. After examining all charge weights and finding none excessive, prudence required reducing the charge to the level listed as the accuracy load. For my Colt AR-15HB, this is the standard safe working load. With a recent article in ***Precision Shooting*** concerning 70 and 75-gr JLK .223 bullets, velocities listed are not close to the edge of the safety envelope.

If one chooses to use the AR-15 in competition, fine, but let's do it with safe and prudent loads. The .223 is close to the equal of the .308 when using the 69 and 80-gr HPBT bullets. So let's take advantage of the .223's lower recoil.

Dennis in North Carolina

Dear Dennis,

When the M-14 became the service rifle in 1957, there was significant resistance to its adoption for competition. In *The American Rifleman* of the early to mid-1960s there were several articles each year debating its merits on the shooting range. Reliability, accuracy, and cartridge choice were all hotly contested, with the final decision coming years later when a service rifle championship was won at Camp Perry. In the 20-plus years since, it has replaced the M-1 on the firing line as the rifle of choice, by a factor of at least five to one.

I look at the past several years as a

repeat of this cycle, wherein the merits are argued back and forth, but can only be proven on the firing line. When Sierra debuted the 69-gr HPBT in the 1980s, the door was opened for the M-16 to shoot competitively, but it needed addition of the 80-gr HPBT to allow equal 600-yd competition. By winning a service rifle championship in only the second year of its adoption by the AMU and All-Guard teams, I find that the AR-15/M-16 confirmed its place on the firing line.

My personal belief is that anyone should use whichever of the three rifles (M-1, M-14, M-16) which they feel they shoot the best. Each rifle, when properly built, will perform competitively against the others. At Accuracy Speaks, Inc., we still build many M-1s and M-14s despite our newfound reputation with the AR-15.

History lesson over, I'll now address your specific concerns.

Loads: I cannot speak for Sierra Bullets, but like yourself, I assume that liability lawyers (may they all be chained down at Perry each year without earmuffs) have written more loading data than engineers. I can say, however, that we have chronographed Federal factory 69-gr ammo at 3,000+ fps and loaded 69 Sierras to 3,100 fps with a clear conscience and no problems. But it does require a chronograph and careful work that not many casual competitors are willing to perform.

We will never suggest ignoring safe loading procedures or tossing your new Sierra manual aside in favor of the older one. The .223 Remington case and small rifle primer do not show pressure in the same manner as the .308 and large primer; many times the first and only indication of an excessive load or external condition is a smoked or blown primer. Reference our load development articles in ***Precision Shooting***, where we list smoked and blown primers as they occurred. As time goes on, more data will become available and the safe, accurate loads will become standard like 4895 and 168s in .308. Until then, loading for velocity by adopting ours or anyone else's data without consideration to component changes or chamber and barrel dimensions is foolhardy at best.

External Ballistics: If you read the preface to External Ballistics in the Sierra manual, they explain how complex and convoluted ballistic coefficients become. In my discussions with Kevin Thomas at Sierra, shooting 168 HPBTs at identical velocities from 10 and 12-twist barrels will yield BC changes of almost 20%. Likewise, changes in temperature, humidity, and barometric pressure will change BCs. Sierra tests all bullets at a standard temp/humidity/pressure to arrive at their numbers, but freely admits that they can go up or down unpredictably by changing the test conditions.

The main point is: ballistic tables are a guideline, not a hard fact. We shoot 69s against 168s all year long, under a variety of conditions, and the empirical data (i.e., conventional wisdom) is that at 200 yds they are equal; at 300 the 168 has a slight advantage (10-15%) that could be made up with better BCs. Both Hornady and JLK will soon debut 75 to 77-gr eight-ogive bullets that should even the wind at 300 yds with the 168.

I can say positively that the 80-gr Sierra at 2,700+ fps will use less wind than the 168. I have not had a chance to test the 175 HPBT very extensively, but my best guess is that it would be equal to the 80-gr Sierra. The 80-gr JLK and other VLD bullets should easily outstrip the 175 HPBT.

At Camp Perry '96 I had a long discussion with a gentleman who was experiencing blown primers with Federal factory 69s. He returned the ammo to Federal and was told that it met their criteria for pressure and velocity. He was quite upset that they would sell "unsafe" ammunition in the first place and then return it as acceptable. He left after a long discussion, unconvinced and frustrated that he could not shoot such "safe" ammo in his rifle.

Similarly, I shoot for the All-National Guard team, and at Camp Perry we had a series of problems with our 600-yd ammunition: poor accuracy, then blown primers in a proven load. The load was reduced again and we had blown primers, but from day to day, guns would alternate having both types of problems. Needless to say, a serious investigation is underway.

Conclusions: (1) Just because it's factory fodder doesn't mean it's safe or accurate in your rifle, no matter who else uses it. There are a multitude of barrel, reamer, throat and gunsmith combinations out there, and they are not all interchangeable.

(2) Just because it worked once doesn't mean it will always work at all ranges, temperatures, and conditions. When and if it stops working, these are relatively uncharted waters and we should expect to discover things. But there is no reason we should all hit the same reefs. Don't be afraid to tell people about your problems. That's most of the reason for ***Precision Shooting*** magazine: group solutions to individual problems.

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CUSTOM CASE CONVERSIONS TO ENHANCE ACCURACY

by

M.L. McPherson

Synopsis: We all know that a tight chamber throat can help keep bullets properly aligned with the rifle's bore and thereby enhance accuracy. This is why gunsmiths chamber custom target rifles with very tight throat dimensions. In most instances, ammunition for these guns requires case neck turning to achieve the necessary clearance. (These custom throats are, indeed, tight.) In many instances, there is an easy and inexpensive way to produce custom thick-necked cases. These cases can exactly mimic the advantage of a tight-chambered gun when used in a standard sporting-chambered rifle.

In many instances, one can very easily convert one type of case into another (shorter or smaller caliber) case. These conversions can result in a custom case that has a thicker case neck. A thicker case neck is beneficial to accuracy in sporting-chambered guns where standard loads have more neck-to-chamber clearance than is necessary to safely allow the case to release the bullet. However, case volume is often reduced and appropriate charge reductions are necessary to maintain safe pressures.

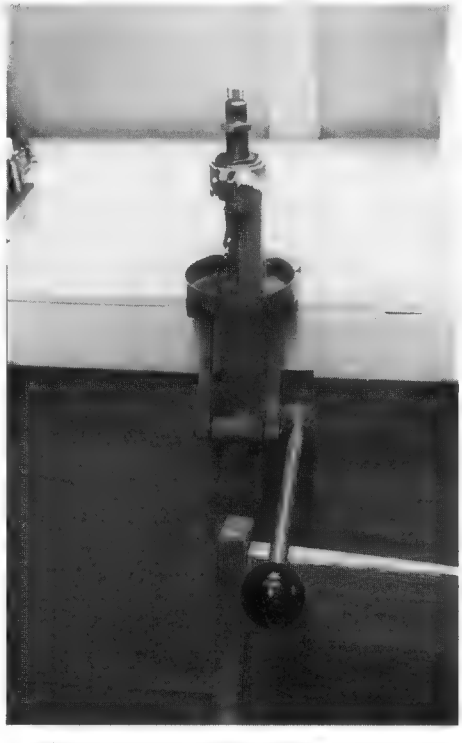
Many potential conversions come to mind. A short list would include: 308 Winchester to 22-250 Remington or 243 Winchester; 7x57mm to 6mm Remington; 35 Whelen to 270 Winchester, 280 Remington or 30-06 Springfield; 338 Winchester Magnum to 7mm Remington Magnum; 375 Winchester to 30-30 Winchester. Some or all of these conversions **might** result in finished cases with necks that are 0.0015-0.0030" thicker than standard case necks for that cartridge. Many similar conversions are possible.

By measuring the original case neck thickness, one can determine if the reduced diameter case neck will be thicker than a standard case neck. In a conversion that pushes the case shoulder back, one can almost guarantee that the conversion will create a thicker case neck.

A few thousandths of an inch might not sound like much difference, nevertheless, this is a substantial increase in case neck thickness. Standard case necks are typically 0.010-0.015" thick, depending upon the cartridge. Most are nearer 0.015" but the 30-30 and other old chamberings are usually about 0.010". Also note that standard SAAMI case-neck to chamber-throat clearance is typically only 0.003-0.004".

We will go through the steps necessary for conversion of cases for one obvious candidate, 375 Winchester to 30-30 Winchester. Other conversions will require different steps and different dies. Our purpose here is to simply suggest case conversion as an alternative (to using the standard cases) and to demonstrate how simply you might accomplish such a conversion.

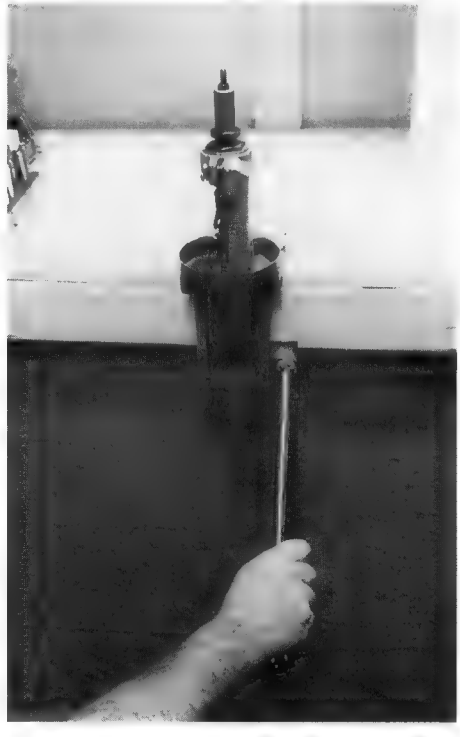
This particular conversion creates custom 30-30 cases with concentric (turned) case necks that are a full 0.002" thicker than standard concentric 30-30 case necks. This conversion creates cases that measure 0.3297" with a standard 0.308" bullet seated. Minimum SAAMI chamber throat specification for the 30-30 is 0.3307". However, most guns will have a throat diameter closer to 0.3317". (This conversion creates cases with just about the ideal neck to chamber clearance.)



38 Spc. bullet seating die adjusted to size only the beginning of a 375 Winchester case. Note chair under press handle to limit the ram's travel. This is not very precise but is adequate to begin case mouth sizing. This step is followed with the 38 Spc. carbide sizing die with the same set-up.

Most shooters would consider 0.001" concentric clearance between cartridge neck and chamber throat to be very tight. Bench rest shooters often use closer tolerances but most other target shooters work for about this level of clearance. Less clearance leads to too many problems in a gun that one just wants to shoot!

Because this is convenient, and because it does limit the possibility of destroying a case during this conversion, I use several steps in necking 375 Winchester cases to 30-30 Winchester. Before any conversion step, I begin with primer pocket and flash hole uniforming. I follow that with outside neck deburring. I then lubricate the case neck with my personal mixture of Hornady's Unique



32 Spc. bullet seating die adjusted to size as much of the 375 Winchester case as possible without applying an excessive crimp to the case mouth.

case lube and graphite (lubricates **extremely** well, cleans the case and is easily wiped off), although any good case lube will suffice.

For this conversion, my first step is necking the case using a 38 Special bullet seating die. This die has a wide flare to accommodate the 375 case neck. This step only slightly reduces the diameter of the case neck but it insures the case mouth is round and that it will easily enter the next die used. In my press, I could not adjust the 38 Special bullet seating die to properly size only the (eventual) neck portion of the conversion case using a normal full-stroke of the press handle. For this reason, a 35 Remington bullet seating die would be a better die to use but I do not own one! This is typical of such conversions, do a little mental work and figure what dies you own that might be useful in stepping the case to the size needed.

I solved the problem of sizing only the portion of the case that would eventually become the case neck by limiting the stroke of the press handle. (I simply set the back of a chair under the handle, limiting its travel so that I could only raise the ram about one-half of its complete stroke, precision adjustment is not important here.

I then inserted a once-fired 30-30 case in the shell holder, raised the ram to its temporary limit and screwed the 38 Special bullet seating die into the press until it just touched the case. I then turned the die back out about one-half turn (this prevents any disruption of the case beyond the eventual shoulder of the finished conversion 30-30 case). Lubricated cases were then run through this die and set aside.

The next step was basically the same process. Here I used the 38 Special carbide sizer die. Again, the 35 Remington sizer die would be a better option, if you happen to have one. However, the carbide die works very well. Here I installed a fired 30-30 case and screwed the die into the press until it lightly touched the case, then backed it off just slightly. I then cycled the cases through this die (lube is not needed here). This step sized the case necks down one step smaller and established a very smoothly radiused temporary shoulder. These features facilitate the next step.

From here it would have been possible to size directly to 30-30. However, I have 32 Special dies and the intermediate steps ease the task and, again, reduce the risk of damaging cases. I removed the chair that was temporarily restricting the ram's travel. My next step was sizing in the 32 Special bullet seating die. I installed a fired 30-30 case and adjusted the die until the crimping portion of the die just began to crimp the case mouth then backed the die off about one-half turn. I relubricated the cases and then processed all through this die (correct adjustment results in the case mouth being turned in slightly by the crimping portion of the die).

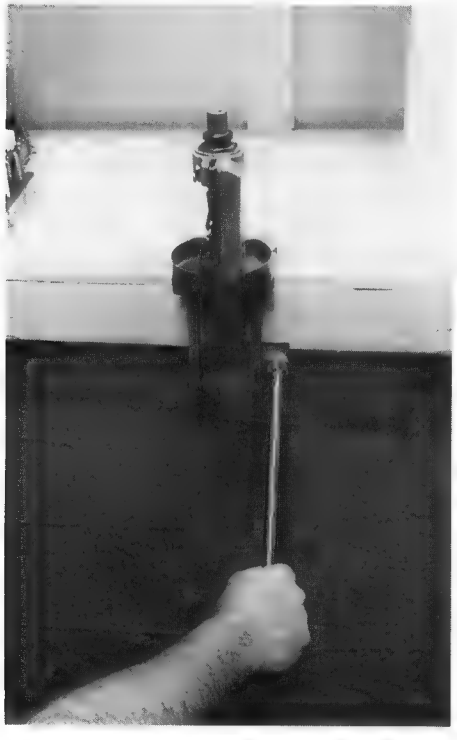
I installed the 32 Special sizing die, sans decapper stem, and screwed it into the press until it contacted the shell holder solidly. I then relubricated the cases and ran each through this die.

Finally, I installed the standard 30-30 sizing die, adjusted it to bottom hard against the ram, lubricated and full-length sized the cases. At this point, the cases are visually indistinguishable from standard sized 30-30 cases.

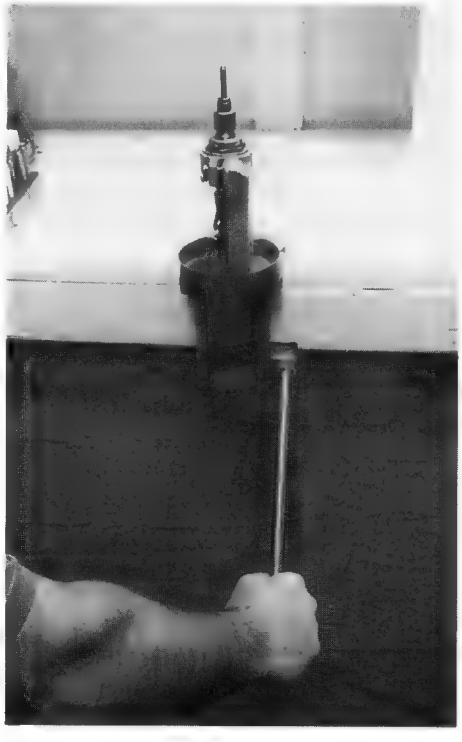
An important thing to reiterate here is that one can accomplish many such conversions with the standard reloading dies one has on hand. However, RCBS offers an extensive line of case forming dies. If a similar case conversion process allowed you to produce cases that created ammunition duplicating a custom tight-chambered barrel, a set of these dies might be worth the investment. However, the handloader can often simply buy an intermediate standard die set, to add to his inventory, and accomplish the same end.

An example of this would be the conversion of 35 Whelen cases to 270 Winchester. Of course, you could accomplish this conversion by going directly to the 270 dies but you might lose a large number of case that way. With a set of 30-06 dies, you could convert 35 Whelen cases by first using the 30-06 seating die, followed by the 30-06 sizing die (with the expander removed) and thereby reduce the number of damaged cases to almost zero.

Continued on next page



32 Spc. Full-length sizing die with decapper/expander stem removed. Adjusted to fully size the 375 Winchester case to 32 Special.



30-30 Winchester full-length sizing die. Adjusted to fully size the 375 Winchester case.

375 Winchester and 30-30 Winchester cases, the 375 has thicker case walls and can be converted to a superior 30-30 case.

CUSTOM CASE CONVERSIONS ...

Continued

With our example (a rimmed case conversion), there is no real safety concern associated with actual shoulder position (headspace). However, in a rimless case conversion the handloader must ensure that he has not somehow driven part or most of the case shoulder back too far in one of the intermediate steps.

Before final processing of these conversion cases, an important step is trimming to length and deburring. I choose to trim to 2.035" because that was the maximum length that would allow all the converted cases to clean up concentricity at the case mouth. Please, note that this is longer than many factory 30-30 cases! Therefore, in this conversion there is a second advantage, longer case necks and COL. Trimming to uniform length is **necessary** before outside neck turning.

I turned the trimmed necks to achieve the proper finished wall thickness. (As noted above, I chose 0.3297" diameter with a standard 30-30 bullet, Speer's 170 grain FN, seated normally). I prefer K&M's hand tool for outside neck turning. Of course, one could accomplish neck turning with any other make of hand tool or either of the RCBS or Forster lathe-type tools. K&M's tool is indexed for repeatable measurements and allows one to chuck the cases into a vised hand drill. Both features simplify and speed neck turning. My final step was to polish the necks with four-ought (4-0) steel wool. I simply left the case spinning and squeezed the case neck with the steel wool between my finger and thumb for about two seconds. This removes any burrs while polishing the neck to perfection.

In this particular conversion, the thicker case neck walls are an advantage for several reasons that have no **direct** connection with accuracy. First, the thicker necks will hold the bullet more securely against recoil in the tubular magazine. Second, the thicker case walls and necks improve the case's rigidity and thereby improve the results and consistency of crimping. (Standard 30-30 cases tend to flex and elasticity shorten during crimping; this creates non-uniform crimps when one uses standard crimping dies.) Third, the thicker case walls and neck make these cartridges more resistant to damage from rough handling.

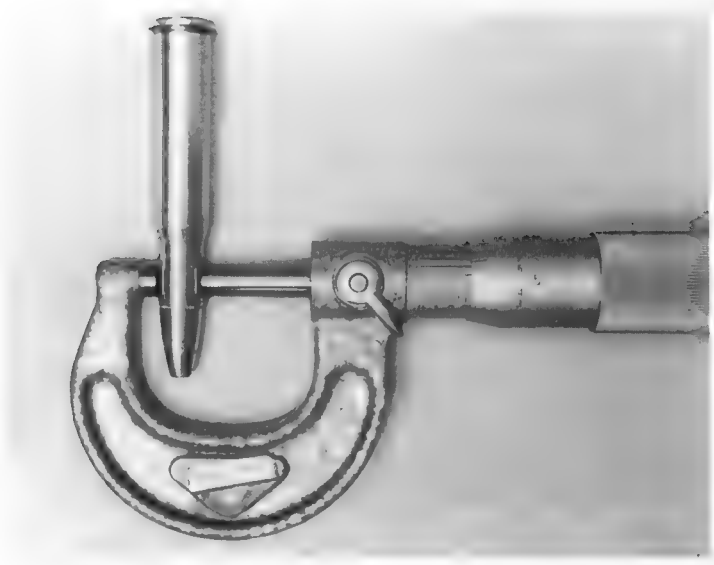
I must reiterate that this conversion, like many similar ones, creates cases that have less internal capacity. Ensure that you compensate for this fact by a proper reduction in powder charge. In this instance, the conversion cases weigh about 15 grains more than typical 30-30 cases. For normal case-full loads, this difference in case weight requires a reduction in powder charge of about 1 grain to keep pressure and velocity similar to that in loads using standard cases.

Of course, owing to thicker case walls, use of 375 Winchester cases will significantly reduce the stress transferred to the gun's bolt with loads generating the same pressure. Compared to typical 30-30 cases the difference is a surprising 9%! This will significantly reduce case stretching in rear-locking guns with loads at the same pressure level. This will also significantly increase the safety factor in the sense that these cases can stretch substantially more at the web-to-body juncture before separation occurs.

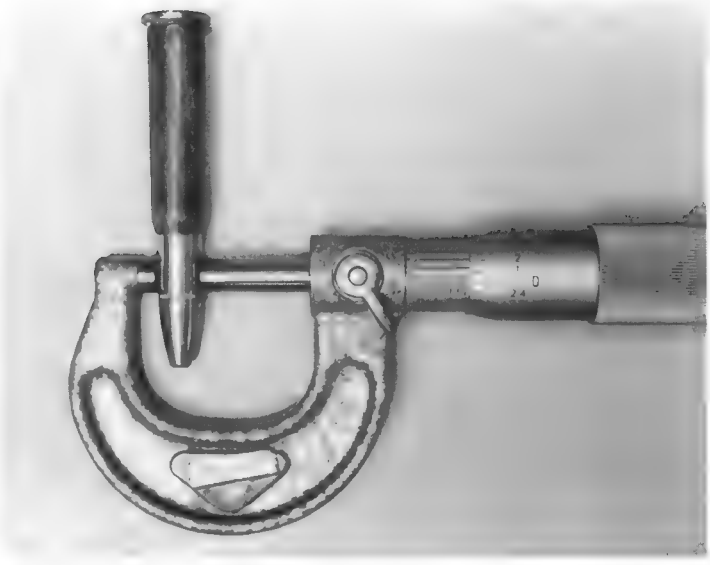
Those interested in maximum accuracy from a sporting-chambered gun should look for similar conversions. The short list at the beginning of this piece is only the tip of the iceberg. In fact, only a very few chamberings, chiefly cylindrical numbers such as the 375 Winchester, 45-70 Springfield and 458 Winchester Magnum, offer no hope of creating cases with thicker necks.

Steps in conversion of 375 Winchester cases into 30-30 Winchester cases, left to right:
New 375 Winchester case
Partially sized in 38 Spc. bullet seating die
Partially sized in 38 Spc. full-length sizing die
Sized in 32 Spc. bullet seating die until crimping portion of die just begins to turn case mouth in
Full-length sized in 32 Special die
Full-length sized in 30-30 die

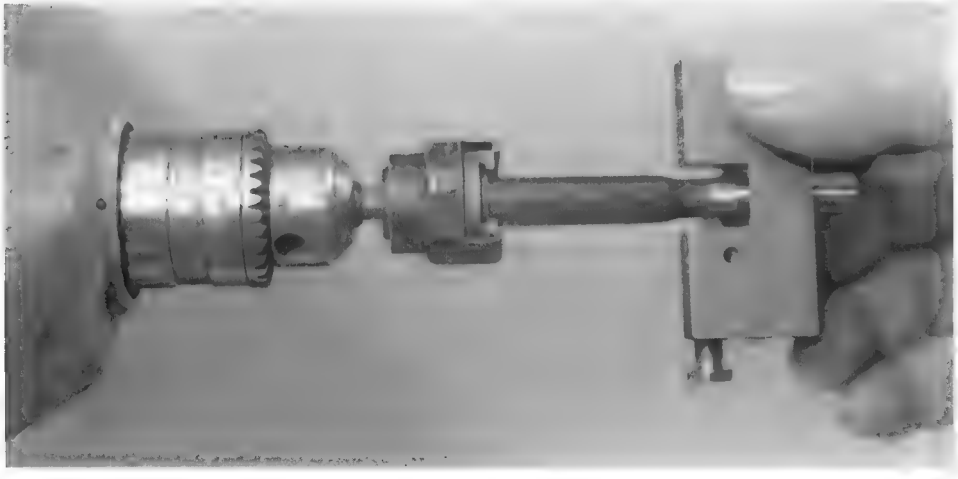
Standard 30-30 case (right), converted 375 Winchester case (left). Note that the conversion case is longer, many 30-30 cases are initially shorter than the suggested "trim-to" length, this conversion allows one to form cases of uniform proper length.



Conversion 375 to 30-30 case with turned neck and Speer 170 grain FN bullet (0.308") seated. Diameter of outside of neck is about 0.3297" with bullet seated.



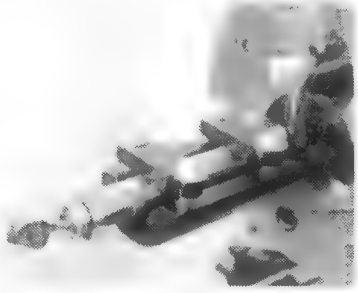
Standard 30-30 case with turned neck and Speer 170 grain FN bullet (0.308") seated. Diameter of outside of neck is about 0.3254" with bullet seated.



Standard 30-30 case, outside neck turning with K&M Services' exceptional tool. Note that this was a corroded case deliberately chosen to show effects of neck turning, note bright new brass. The drill is vised and locked on at a very slow speed; this allows the operator to concentrate on slowly advancing the cutter.

This sort of conversion would not be so simple! Taking a 50 BMG to 17 caliber requires hydraulic forming, many special firming dies, repeated neck turning and neck annealing. Still, losses are common on such radical conversions.

THE LaBOUNTY BOLT FIXTURE



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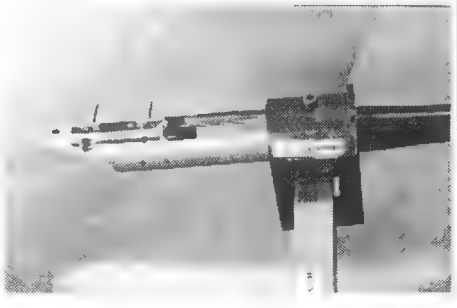

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THE D.C.M. CLINIC

by

Roy Baumgardner

The D.C.M. Clinic, which is a two day school sponsored by the Ohio Rifle and Pistol Association (O.R.P.A.), with support by the Director of Civilian Marksmanship, was held April 29th and 30th at Camp Perry, Ohio. The purpose of this school is to introduce junior and new adult shooters to the fine sport of service rifle shooting over the National Match course, and to provide an opportunity for civilians, both juniors and adults of either sex, to develop a fair degree of proficiency and experience with the service rifle, and to instruct these people in how a range is operated in the pits, on the firing line, and in the statistical office.

All those taking part in this school must be members of the O.R.P.A. or a member of their home state association. Membership in the Ohio Rifle and Pistol Association is just $15.00 per year for an adult. Juniors are $5.00, and spouses are $8.00. (Cost of the school, for an adult, is $40.00). The school is open to all junior shooters age 12 through 20. Although the age 12 rule is not set in concrete, and is very flexible, going more on stature, size, and ability rather than date of birth. In short, if the instructor feels that the kid can do it with their 100% assistance, they will not be refused entry.

All officials and instructors are volunteers, and come from all over. Youths supervised by adults are used to run phones, lunches, or wherever they can best serve. The accent is on safety, fun and learning.

The first day starts out at 6:00 AM, when the Stat Office opens on Saturday, and many who have driven long distances through the night begin filing in to register. (Kind of like some bench rest matches). At 7:30 the school begins in the Post Theatre, and covers safety, rules and range commands (what they mean, and why they are used), duties and responsibilities of competitors, equipment, marking and scoring of targets, aiming positions, use of the rifle's sling, effects of weather, and how to zero the rifle, use the spotting scope and loading and unloading the M-1 rifle (which is what they will be using). Much of this instruction is accompanied by a slide show presentation on the stage's large screen. At 10:00 AM they are sent to Perry's historic Vaile 1,000 yard range to meet their individual instructors, and report to the firing line, or pits, depending on the relay they draw at squadding; they will fire on the 200 yard range.

The volunteers that instructed the students in the pits. They come from all walks of life, and are quite presentable when it is not raining.

Over the years, I have worked with many organizations, and some corporations, that were so rigid and inflexible in their operations that they were unable to make even the simplest of changes, even when things were coming apart all around them. Happily, this is not the case with the O.R.P.A.

The biggest change to confront them, and all of the rest of us, I might add, is the age and gender of the average student. This became very apparent to the N.R.A. a few years ago, and it is still progressing, thank goodness.

What is happening, is that every year our population is getting larger (so...what else is new?). This has caused urban expansion that has closed many ranges. This is the bad part. The good part is that each year there are more new shooters than the year before. These new shooters are now appearing on the ranges younger (with more females in the group) than ever before. Many of these students are quite small in stature for the full size, nine pound, M-1 Garand. This also goes for the adults, many of whom have never fired anything but a .22 in their life. What this means is that the N.R.A.'s air gun and small bore programs are working, and working well.

To blend smoothly with this change, the O.R.P.A. has placed most of the decision making on the individual student right with that person's individual instructor. They also modified the National Match course of fire to where it is much easier for the new student to learn. They now refer to it as the Adjusted National Match course of fire, with sighters. It is extremely flexible.

The student is started off prone, slow fire, with zeroing going on by the instructor as they learn. This may not be limited to the 10 shots if the individual instructor feels that there is a need, or time permits more. (Read: If you are having fun, keep shooting until the time runs out). The instructor can also put the student on a sandbag, or other rest, if deemed necessary.

The second stage is standing to prone, rapid fire. Again, the instructor has full

The D.C.M. clinic school starts with the students reporting to the post theatre.

The newest thing at Perry is a small tower at the road that separates Young and Vaile Ranges.

authority and can start the student out prone, or over a rest if they want to. This is considered easier, and also safer.

The third stage is standing to sitting, rapid fire. The instructor can help, or completely load for the student at any time if he feels that his instruction is best served by doing so.

The last stage is offhand, slow fire, with the instructor right by the student. The instructor has the right to choose any position he feels that the student may be more comfortable with, including sitting or prone, while any stage is being fired.

Any of these stages can be changed, or mixed, if those in charge want to. This has proved to be safer, easier, and allows those in the pits complete flexibility, as all rounds are fired at 200 yards only. During the rapid fire, the officials have the right to leave the targets up longer than the 60 or 70 seconds normally used during sitting and prone. As a matter of fact, they can even wait until they hear the rate of fire slackening off before ordering the targets pulled down if they want to.

Does this system work? Yes, it does work, and very well! Gone are the days when one, or more, of a group of students went home feeling bad because of a very poor performance their first time out, or even failing to get on the target. Can it be made more challenging according to the student's ability? You bet it can. The instructor has the right to make the student conform closer and closer to the real rules, right up until they reach the same standards as those at the Nationals. But this has yet to be needed.

The second day, Sunday, things tighten up a bit, as a two person team practice match, with awards, is fired. The student is now teamed with the person they drew as a scorer, and medals are given down to sixth place, with teams arranged as to age, junior or adult, or parent and junior. The student again draws the same rifle, a standard issue M-1 Garand, and again, 30-06 ball M-2 ammunition, with its 150 grain, full jacket Spitzer flat base bullet. Also the same target and instructor. The accent is again on safety, learning, and a fun experience.

Most instructors feel that the first thing a new student has to learn is the basic sight picture. It is surprising how many who have never even fired an air gun, or those who received a very brief introduction on a scope sighted .22, do not understand how to use peep sights, and will often look over the top of the rear sight to put the front sight on the target. So, if the instructor has the slightest doubt, they quickly draw a sight picture on the page of a notebook, or on the back of a cartridge box.

The weather on Saturday was cold and windy, and of course on Sunday it got worse, as it now rained off and on. In spite of this, there were almost no drop-outs from the over 500 students.

On Saturday I took pictures, and talked to various students and instructors. Then, on Sunday, I reported to work in the pits to Glenna Grannis, where I was assigned to the high end of the target line as a block officer.

Glenna trained with Ralph Reichman and Mike Clemens. Ralph now runs the firing line and Glenna is the chief pit

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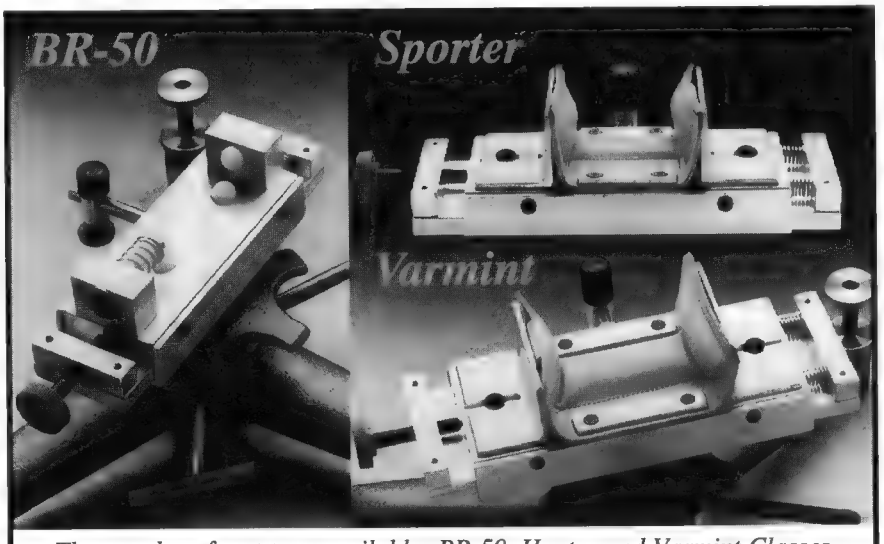

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THE D.C.M. CLINIC

Continued

officer. Mike is off right now with some health problems, but I talked to him for a while during the event, and it looks like he will soon be back shooting.

Over the years, more and more women have become officers in the O.R.P.A., and they do an excellent job of it, and are very easy to work with.

The latest news from Perry is that there is now a new tower on the 1,000 yard line, at the road that separates Young and Vaile Ranges. This tower is about 20 feet off of the ground, and supports a glassed in room of about 12'x12' size. I was told that it will be used to overlook and control some pop-up military targets that are normally flush with the surface of the ground. They have also installed a lot of below ground drains on the ranges to help get rid of the surface water quicker when it rains, or snow melts.

As this is being written, the sadness of the loss of life from the bombing of the Federal Building in Oklahoma is a very real thing. Along with this, our news media has now decided (after many years) that there is a difference between our National Guard and Militia. We were told previously that there was no difference, and as such, individuals did not have the right to keep and bear arms. The newest spin is that anyone involved in a firearms training course must be a terrorist. This news was somewhat frightening, as many of the young students involved come from the 4-H programs and the Girl Scouts of America. This was discussed at some length, and it was decided that we would continue to buy their peanut butter cookies from them, even if it meant that we were aiding and abetting them, as it was not considered that the threat of an overthrow was all that great.

Also at the clinic, a long-time friend, Don Link, showed me a slick tool milled out of a block of aluminum that slips on the sight of an M-1A. A screw is used to move the front sight the necessary number of thousandths of an inch to center it with the mechanical zero markings on the rear sight, after this is arrived at by shooting the load to be used. A machinist's dial indicator gives the readings as the sight is moved. It is both simple and effective.

To get more information on the clinic, get in touch with Barb Smith, P.O. Box 11490, Columbus, Ohio 43211.

The search for accuracy never stops.

The over 500 students walk down the road that separates Young and Vaile Ranges, to the targets at Perry.

The ladies that ran the pits at the D.C.M. clinic at Perry. I worked for Glenna Grannis, shown here in the center.

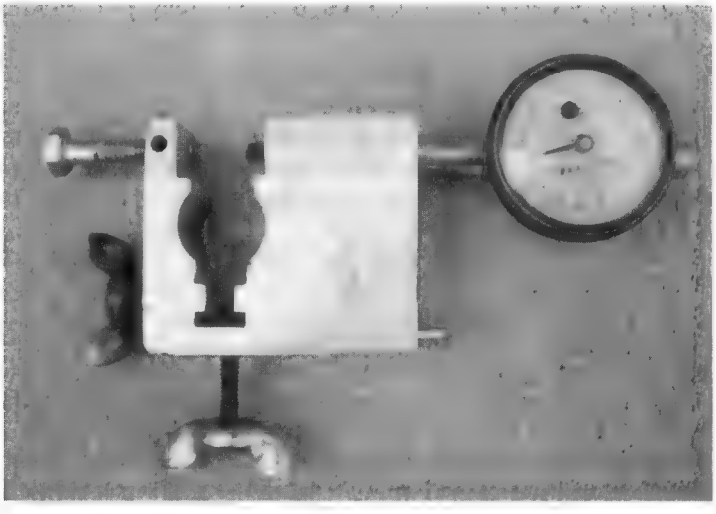
Kids are used everywhere at the clinic. This one worked one of the phone lines from the firing line to the pits.

The pits at Perry. This was our beat for the cold, rainy weekend.

The M-1 Garand. After almost 60 years, it continues to train students. Here the instructor counts the rounds as they are fired.

The average student is younger every year. Also, the number of female students gets higher every year. This one is learning how to work the bolt on the M-1 Garand

Two students score a target by placing red painted golf tees in the holes. The tees heads were painted by placing them in peg board holes and spraying the lot with florescent red.



Long time friend, Don Link, showed me a tool milled from a block of aluminum, that is used to zero an M-1A's front sight with it's rear one.

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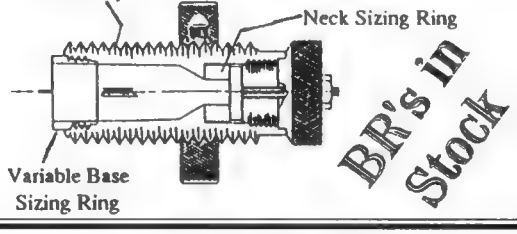

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SHOOTER'S KNIVES PART II

by

Joe Rychetnik

Before WW II (we won that one, remember?) just about every man carried a pocket knife. More people lived in the country then and farmers, ranchers, people who worked with their hands in shops and in the trades all had a favorite piece of pocket cutlery. Before TV, whittling was a great time passer and if Southern tradition is to be believed, men would sit on benches in the hundreds of small towns and together reduce our national forests to fine shavings with a Case or an Imperial or Shrade pocket knive.And knives by Remington and Winchester,as well.

Today men carrying pocket knives are suspect and only the throw backs like me dare to carry such weapons day to day. I always watch the plastic trays at the air line security inspection zones. More often than not a guy will toss out a ring of keys with a BMW or Benz logo key fob. Seldom a knife. When my 35-tool Swiss Army Knife hits the plastic tray before I pass through the metal detector, everyone turns around.

"What are you going to do with that thing?" the big eyed inspector will ask.

"I may be able to help the pilot if the wings start to wobble loose," I tell them without a smile, and reclaim my quarter pound pocket tool box.

Now we have a swing in the cutlery pendulum. Knives are coming back. Some very good ones are being offered in a myriad of specialized forms. I just completed a major article for KNIVES '96 DBI Books on pocket tools and realized too late in the game there was a never ending stream of such knives coming on to the market, following the tradition of the Swiss Army knives, and their imitators. Knives for shooters and gun nuts are no exception.

I mentioned earlier the quite good Shooter's Knife by Hoppe's. The strong features are the large lock blade and the many "screw" drivers that a shooter would find useful. Case has brought out two similar knives as there are no secrets in the knife industry, every niche is covered quickly. Way back in the days of muzzle loaders, a patch knife, for trimming the fabric around the ball at the muzzle, was part of every hunter and militiaman's kit. This was a knife, with blade shaped to make the job easy.It was always a separate knife from the hunter's belt knife. Many shooters carried it in their Possibles bag.

I have been working and playing with two pocket knives offered by the Remington Arms Company. They are made by a well known knife manufacturer, the Smoky Mountain Knife Works of Savierville, TN. The Delrin handles on both of my knives, the Upland (RI-D Model) and the Waterfowl (R2-D) are tough and after a month of using them for every pocket knife task, have not shown any wear. The blades are 440-C type stainless and both came sharp as I'd want them, right from the plant.

My favorite turned out to be the larger knife--the Waterfowl. The three inch sabre blade would do well on small game and large bird skinning and cutting tasks. The other cutter was a two inch serrated blade that cuts like magic and is ideal of cutting light bones, tendon, and other tough materials. Many users are afraid to put a serrated to a tough job, because they claim that once dull, it is difficult to sharpen. But it is twice as easy to sharpen as a normal blade. Only the back, or none scalloped edge side of the blade, is sharpened on the stone and in my experience, it seldom needs it. The serrated edge is taking over the blade style of many knives.

The screwdriver blade contains two ground projections from the "blade" useful for tightening or removing 20 ga. and 12 ga. choke tubes. Remington recommends unloading the gun before attempting to do this and I think you will make this mistake only once. The implications could spoil one's day.

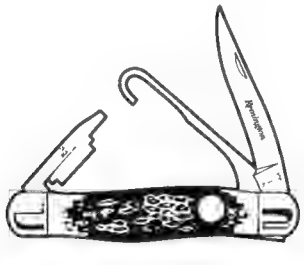
The point of that blade is a screwdriver that will perform many gun related tasks. Another "blade" is a tool shaped like a nail that is an excellent drift for starting and removing gun action pins. I like the heft of this knife.

The second Remington I used this past July was the Upland model. Three blades – one a fine 2.5 inch saber, the other the choke tool and screwdriver and the third a gut hook for eviscerating small birds. I used the serrated blade so often on the Waterfowl model that I missed it on the Upland. The gut hook makes a fine device for hanging the dirty or wet knife in a camp situation.

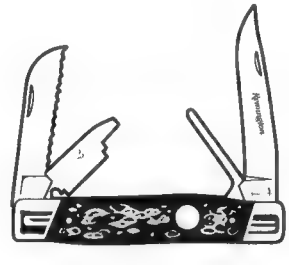
Most pocket knives soon become packed with lint, dirt, and debris from a cutting job. Every time I find my pocket knife grungy, I take it to the kitchen sink, run hot water over the insides. pour in a drop or two of Ajax dishwashing detergent, flood the knife again with hot water until the suds and crud are out and turn upside down to dry. If anything is really stuck deep inside the knife, a Q-Tip or stout tooth pick will clear it out. Run enough hot water to heat up the knife so it will dry quickly. Then a drop or two of Rem Oil or something of similar quality to lube the joints.

If you store knives between seasons, nothing protects better than A G Russell's "Rust Free", a non-petroleum metal coating that works well on knives, guns, and tools left idle for long periods. Better than ANY of the popular sprays advertised today.

Knives and guns go together. The new knives created for shooters seem to make sense. In guns as well as knives, one gets what one pays for – bargain knives are no bargain in the end.



UPLAND KNIFE (DELRIN STAG)



WATERFOWL KNIFE (DELRIN STAG)

BIG GAME KNIFE (DELRIN STAG)

FASTER MOLY BULLETS

by

Dave Scott

As exciting a development as moly-coated bullets are, the coating process itself is akin to watching your fingernails grow. NECO, the originator of impact moly coating and supplier of components, states that the moly-coating portion normally takes about two hours in either a vibrating or rotary tumbler. Five hours, NECO further notes, is generally excessive and should be considered the maximum tumbling time. In his informative article in the October, 1996 issue of ***Precision Shooting***, Randolph Constantine settled on 2-1/2 hours with his RCBS Sidewinder rotary unit. Fortunately, the remaining step in the process, wax coating, takes just a minute or three.

Can applying moly to bullets be accelerated, or are we destined forever to devote all our winter evenings to slowly processing enough bullets to get us through the summer? To resolve this searing question, I retired to the garage and built a Rube Goldberg-style tumbler using a short length of 4" pvc pipe, ball-bearing wheels from my daughter's roller skates, a defunct hand drill, a flywheel from an old tape player, a fan motor and scraps of lumber.

Without boring you with the details of construction, the purpose of this project was simply to create a tumbler with widely adjustable rotation speed. This could be accomplished by varying the diameter of the drive wheel and by selecting either of the two fan motor speeds.

When I plugged the completed contraption in, it turned out that the drive-wheel size I had selected, along with a "hi" motor setting, resulted in the pvc drum rotating one revolution in two seconds. This seemed like a promising place to start, so I took an 8"-tall plastic bottle having 3" sides, partially filled it with NECO steel shot and added a pinch of moly. I dropped in 100 6mm bullets, wrapped the capped bottle in thin foam rubber, pushed it into the pvc pipe, capped the pipe and inserted it into the ball bearings it turned on. That done, I stood back and again plugged the monstrosity in.

With the bottle resting horizontally in the pvc drum and the shot and bullets rapidly cascading on its perpendicular sides, the sounds from within indicated that considerable action was occurring with every revolution. After 15 minutes I shut the operation down and extracted a few bullets. Scrubbing away the loose moly with a paper towel, I saw that the projectiles exhibited a slight copper hue through a developing coat of the black lubricant. Plating wasn't quite complete.

Another 15 minutes of tumbling (30 minutes total) resulted in bullets that appeared to be fully coated. I removed several of these, marked their bases and continued to tumble the rest for another 30 minutes. Under bright lighting and peering through magnifying glasses, I was able to separate most of the 30-minute bullets from the 60-minute bullets. Not all, but most. However, it wasn't easy. In any case, 30 minutes wasn't adequate.

Another 10 minutes added to the 30-minute bullets did the trick. I definitely couldn't distinguish the bullets tumbled 40 minutes from those tumbled one hour. Additional tumbling of the one-hour bullets produced no visible improvement over the 40-minute projectiles. Apparently I had stumbled into a rotational speed and container configuration that did the job quite nicely in just 40 minutes. I feel that this is as fast as this particular drum should turn. On the other

Continued on next page

Created from discarded items gathering dust in the Scott garage, this tumbler nevertheless moly plates bullets in 40 minutes flat. The square, plastic bottle, partly filled with steel shot charged with moly, serves as an agitator when inserted into the pvc drum.

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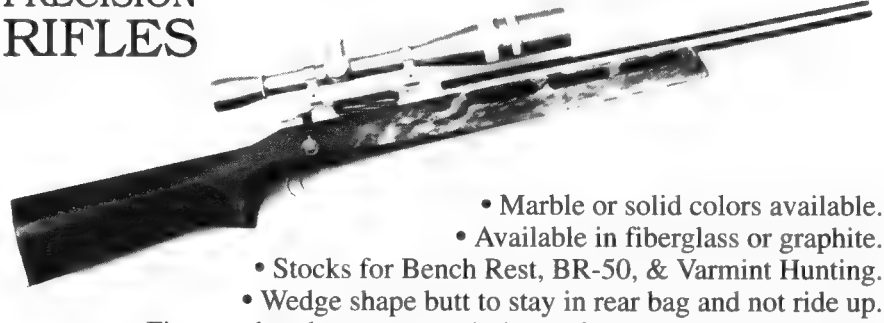

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hand, slowing things down would probably only lengthen the treatment time.

After a one-minute tumbling in wax, the moly-plated bullets left a very faint moly smear when rubbed across the palm of my hand. Perhaps it was only imagination, but it seemed that two minutes of wax coating sealed off the messy lubricant a tad more thoroughly. In any case I settled on two minutes for this last step. That done, the bullets were complete.

Not surprisingly, my micrometer indicates that treated bullets most assuredly do "grow" somewhat in diameter. Before processing, John Herold's .22 bullets measured .2242" on the pressure ring and .2240" on the shank immediately ahead of the ring. Just after tumbling in moly I wiped several bullets clean of the loose powder, and they miked .2244" on the pressure ring and .2242" on the shank—a growth of .0002". For what it's worth, after wax coating the bullets grew yet another .0001". According to my calculations, that amounts to a .0003" fatter bullet.

To date, I've turned out about 1,000 beautiful .22 and 6mm bullets with my apparatus, subjecting the projectiles to 40 minutes of moly bombardment and two minutes of wax. But before I began this article I wanted to again confirm that my standard treatment was correct. I tossed a few .30-caliber Speer bullets into the bottle, tumbling half for 40 minutes and the other half for two hours. With the bullets wiped clean of excess moly and marked, I studied them until my eyes blurred, and I could not detect any difference whatsoever. Forty minutes had definitely done the job.

Which group of bullets was tumbled for 40 minutes and which for two hours? It's immaterial, since they're all identically coated with moly.

The question quite naturally arises whether or not the vigorous tumbling action damages bullets. Nah. I've closely inspected many of the rifle bullets I've processed, as well as the soft lead nose of a jacketed handgun bullet, and I've detected no problems, no side effects, nothing detrimental caused by the speedy processing.

I never would have thought it when I began this project, but I've abandoned plans of ordering a shiny, manufactured tumbler that takes hours to do the job. Even though in its present configuration it has limited capacity, I'll stick with my 40-minute model. After all, this creation has got to justify my $1.71 out-of-pocket expenditure.

It would seem there's a glaring need for some enterprising company to develop a special tumbler for moly coating bullets in minimal time. Perhaps good engineering design could trim tumbling time to 20 or 30 minutes.

Otherwise, the growing hordes of shooters who have sworn allegiance to the silvery bullets are going to be slavishly fiddling with the involved machinery a lot more than is really necessary. Not to mention those exorbitant electric bills.

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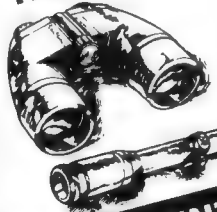

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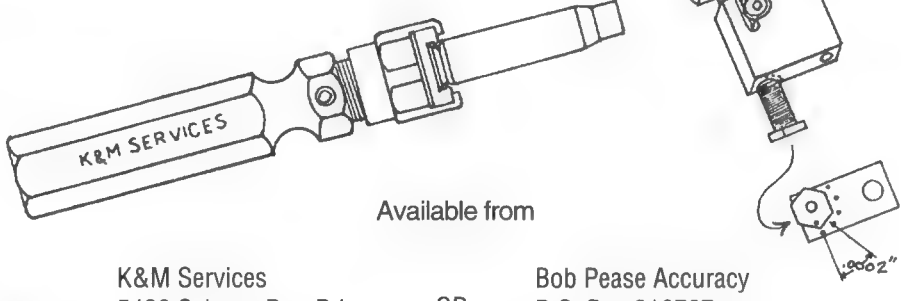

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THE BALLISTIC RECORD OF THE RIFLE IN HIGHPOWER COMPETITION

by

Frank D. Randall

It is my opinion that most highpower rifle competitors fall into two distinct categories where accurate record keeping is concerned: too much or not enough.

We commonly refer to the record book as a "scorebook". Keeping scores is not the primary purpose of the book; it should be used to record information that is paramount to achieving progressively higher scores, information that must be studied and evaluated as time goes by to ferret out the recurring errors and bad habits that retard progress. Most high masters do not keep copious records. G. David Tubb, ***PS*** columnist and many times winner of the national championship, high master of high masters, has stated in his excellent book on the subject that the extent of his record keeping consists of zero settings for various yardages written on a label which is pasted to the side of his rifle stock. I have seen Vince Greiner, several times service rifle champion, refer to a piece of cardboard torn from a cartridge box for zero settings and proceed to shoot X's for sighters, the only extent of his record keeping. Gary Hudson, national long range champion in '94, keeps no record book, nor does Frank Van Cleave, winner of the Wimbleton in '92 and always in the top ten shooters in the nation.

Frankly, I always hated to fool with the blasted things. When the Major asked for scorebooks so that he could pick his best shooters for a team match, mine was the worst kept book of the batch. After observing the aforementioned high masters shoot the center out of the X ring without ever picking up a pencil I cast mine aside completely. When I finally realized that my wood stocked bolt gun belonged to the World War I era and decided to try more modern equipment, I borrowed a Bill Wylde built AR15 from a good friend and fellow competitor, John Rey. It came with a data book that was nothing but a pocket notebook, meticulously documented with essential data such as exact zero's used that day, load data, accumulative number of rounds fired through that barrel, and any data that a shooter might need to know in order to start with center hits. I studied the book and had little trouble from match to match putting the right zero's on the gun. The one day that I forgot it saw me in a blind panic until I rounded up John Rey who gave me enough data off the top of his head to get me started. This little notebook, not the detailed plotting of groups that some do, started me thinking. I referenced Townsend Whelen's *The American Rifle*, published in 1918, and found that even in those early days the military rifle teams considered record keeping essential. He though that the use of the term "scorebook" should be replaced with "The Ballistic Record of the Rifle". I agree.

One of my favorite fellow shooters has always been George Shaw, a quiet gentleman who has proven to be one of my best coaching partners. By that, I mean that I am the student and he is the teacher. George Shaw is the only shooter that I know personally who can keep a scorebook properly and not let it interfere with his shooting, and he will waste no time in admonishing those who do otherwise. Matter of fact, he is the only high master I know who writes anything down. His theory is, you don't diddle in the scorebook while the target is up. If it is kept properly, you can record data as the target drops into the pits for scoring and still be ready to shoot when it comes up during the slow fire stages. He does it this way: The first shot is fired offhand, the target goes down and the call is noted on the data book and another round placed in the rifle. The target comes up and a mental note made of the hit. The second shot is fired and immediately note the call of the second shot and the hit of the first. If a change in sights is made, that is also noted. I repeat, when the target comes up, make a mental note of the shot marker and fire the next round. As the target drops into the pits, record the hit of the previous shot and the call of the one just made. This is not easy to do and

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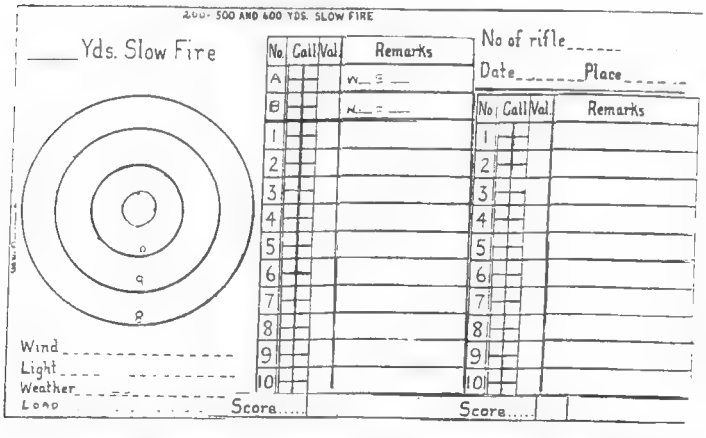
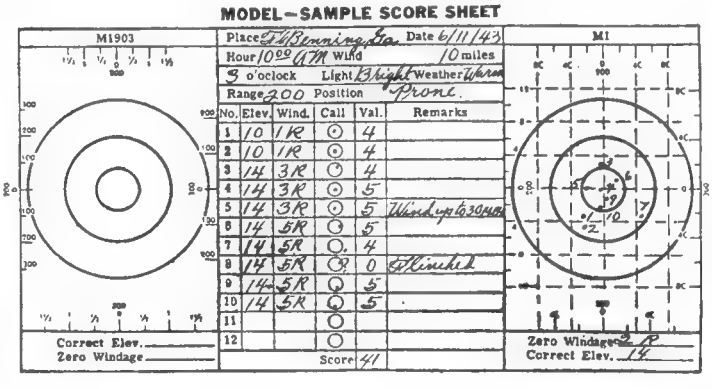


This is from the army's data book circa 1909. Even today it remains a good and simple method of recording what you and the rifle are doing.



The military used data books as far back as WWI during target practice. This sample page is from the early 1940's. Left hand target is for men shooting a real rifle.

THE BALLISTIC RECORD...

Continued

not for everybody, but it can be done. I doubt that match rifle shooters will find this kind of record keeping as necessary as service rifle shooters. George started off on a military service rifle team with several rifles for each shooter. Such detailed records are necessary if you intend to shoot for leg points with different rifles when sighting shots are not allowed.

There is no excuse for not plotting rapid fire groups. When the scored target comes up the shooter has nothing to do but wait for his scorekeeper to record scores. Take a minute and plot the group. Later on, comparison of zero's, sighting shots, and actual 10 shot groups can certainly do no harm. It can and will reveal recurring bad habits or rifle faults that would otherwise remain a mystery.

The beginning service rifle shooter will find a data book much more essential than a high master shooting a match rifle. Most of us are in the group between these two. Thus, the typical high power shooter should keep some data without letting it interfere with his shooting. I have seen shooters fire a round offhand, sit down and pick up the data book, look through the scope and spend perhaps a full minute "diddling in the book while the target is up". This is definitely not the method George Shaw had in mind. Conversely, beginning shooters who keep no records are equally in error. If, like me, you are a middle of the road shooter consider a happy medium.

I find the standard service rifle data book too complicated to use with the small amount of time allotted. Some targets are back up in five to seven seconds if the pit pigs are in fine form. If the target stays down more than 15 seconds the scorers deserve chastisement in no small amount. So pick a simple data book or, do as I do, design your own. Draw off the pages as you please and run copies while the boss isn't around the office. I extracted the one from Townsend Whelen's 1918 book and redesigned it to suit myself. If you are noting in it as you shoot slow fire, a large target diagram with plenty of room for comments is best. Remember the motto of the US Marines: "KISS" - or "Keep It Simple Stupid!". Some shooters like to write down the value of each shot as it is scored. If your scorekeeper is on the ball, you need not. If he is a junior grade, you might want to. It is a good idea to have him call the value out as he scores you, just to be sure. I like to hear my scorekeeper say, for instance, "Your 15th shot for record is a ten". If you only have four rounds left to shoot, he has missed one somewhere along the line. If he is scoring me correctly, I don't write down any values. I especially want accurate and detailed information on my initial zero sight setting and exactly where my sighters go at all ranges, most especially at 600 and 1000 yards. A good shooter using a superior match rifle with really good info. on zeros can shoot two tens or two X's for his sighting shots and this, fellow shooters, is getting a head start on a good score. I don't care what anybody else says, this is the way to start a long range string - with good information! Ye Olde Scribe is middle aged and can't remember that well. I want my data written down and handy.

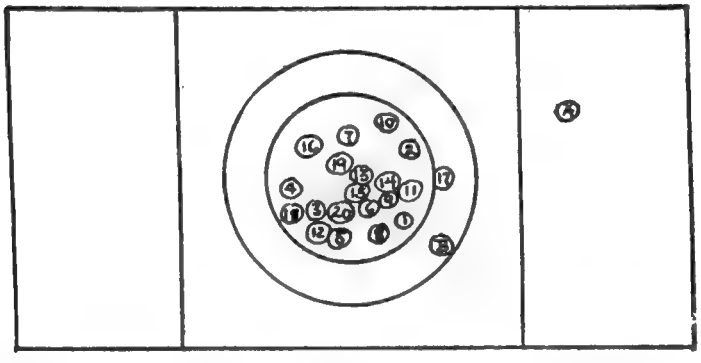
I highly recommend that you average your sight settings for each yardage and write or type it on a stick-on label. Placed on the stock of the rifle it will prove to be a lifesaver if you leave your data book at home.

I started off with a small pocket notebook, similar to friend John Rey's, but found it too small. I now use one with pages 3½" by 6½". George Shaw says to fill in as much as you can before you leave home that morning, i.e. the date, place, rifle, load, etc.. Before shooting, add notes about the weather, conditions, and any other last minute data. I record zero used and zero corrected. I plot my two sighters and any changes made. Shooting offhand I do not plot the group, but I should. I have lost points by not having a bit more windage or elevation on. Plotting the group will tell you this. I jot down the total score of the string as I finish. That's about it for offhand.

After finishing each 10 shot string of the rapid fire strings, I take a minute to plot the group exactly. Again, I note my zero's and sighters precisely.

At long range prone, I note the zero's and sighters, and if it goes right in there from the start with 10's and X's, I'll be damned if I will waste any time "diddling in the scorebook". I shoot just as fast as I can before the tension wears out my nerves and my old eyes begin to fade on me. Also, the quicker you get thorough the better chance you have of "shooting through a condition" before it changes too many times. I have watched amateur backyard benchrest shooters shoot five or ten shot groups very slowly, trying to keep the barrel cool, while the wind switched five times with the light changing as the sun went in and out of the clouds.

Lots of times during the match I will keep scribbling notes as I go on my clipboard. Then over coffee on the kitchen table at home I will neatly fill out a page in my data book, even transcribing and plotting groups. I'm looking at a note

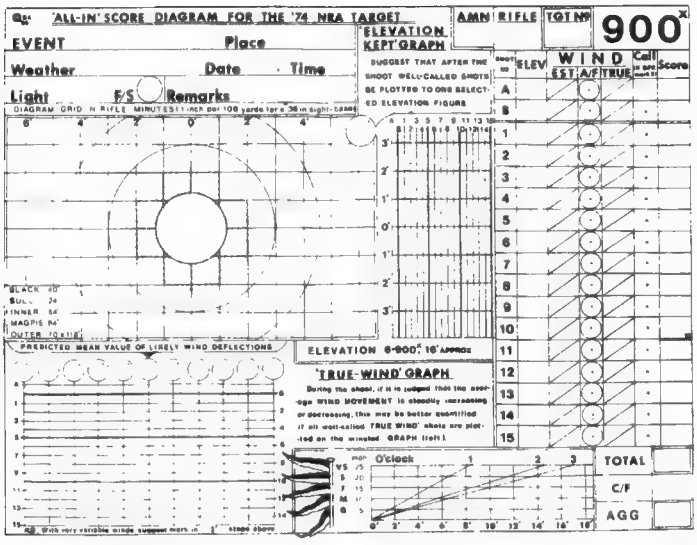


Range 1000 Yds Date 8/17/09 Rifle 178176 Event. Regulation Service Match, O.S.R.A.
Location Camp Perry, Ohio Time 7 a. m 8 a.m Ammo UMC 172 gr

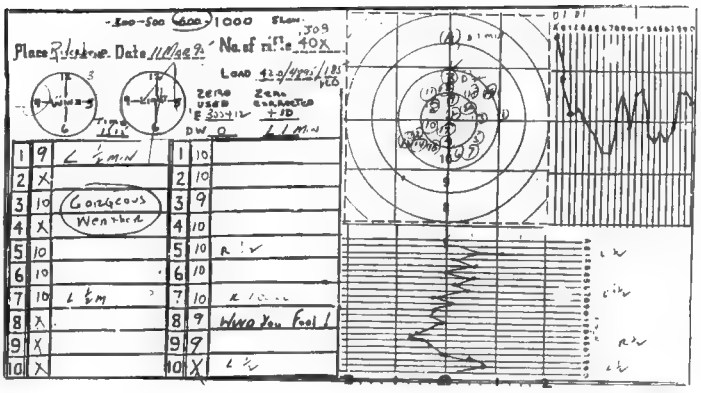
Bar	Tem	Hyg	WIND Dir	WIND force	Flag	LIGHT F.P.	LIGHT Tgt	Mirage	No	Elev.	WINDAGE L	WINDAGE R	Call	Score	Notes
29.15	77		11:30	8		D	D	—	55	71	1⅛			2	
			W	-	-	-	-	—	55	-	2			4	
			10.50	-	-	-	-	—	1	72	2¼			5	
			-	-	-	D	B	—	2	-	2½			5	
			-	-	-	D	D	—	3	-	2⅔			5	
			-	-	-	-	-	—	4	-	-			5	
			-	-	-	-	-	—	5	-	2½			5	
			11.30	-	-	-	-	—	6	72.5	2¼			5	
			-	-	-	B	B	—	7	-	2⅛			5	
			-	-	-	D	D	—	8	-	-			5	
			-	-	-	-	-	—	9	-	-			5	
			-	-	-	B	B	-	10	-	2½			5	
			11	-	-	D	D	Poor	11	-	2⅔			5	
			10.45	-	-	-	-	—	12	-	2⅛			5	
			11.30	-	-	-	-	—	13	-	2½			5	
			11	-	-	-	-	—	14	-	-			5	
			11	-	-	B	B	—	15	-	2⅔			5	
													TOTAL	99	

No	Dir	W.G	Score
16	11:30	2½	5
17	11.45	2¼	4
18	11	2⅜	5
19	11:30	-	5
20	11:30	-	5

Here's a page from Colonel Whelen's data book circa 1909. He says that this is exactly as he kept it during the match. Note the time recorded as 7 to 8 a.m. There's no doubt that it took an hour to do this much diddling with a few minutes left to shoot.



Long range big bore shooting in the English Commonwealth countries is mostly prone, slow fire at the longer ranges. Often two or more shooters are squadded on the same target, firing one after the other. Thus, several minutes may elapse between your rounds fired. They use this extra time to diddle in a scorebook, even plotting graphs to predict wind deflection. Perhaps laptop computers on the firing line are next.



The English method of plotting graphs while shooting is illustrated here. As soon as the shot is marked on the target diagram follow it straight over to the right and mark it on the elevation graph, then down and mark it's location on the windage graph below. Draw the lines as you progress from dot to dot and a pattern will emerge as you shoot. I don't think the elevation that important unless the sun is moving in and out of the clouds causing definite changes in your elevation. The wind gauge can be interesting indeed. Remember that the English have much more time between rounds fired than we do. Plotting graphs is time consuming. It would be fun to do this for the fellow shooting while we score.

now that says "Gary Hudson said that he forgot to put on his mirage band and shot all around the X ring. When he put the band on it went right into the X ring with 6 straight". I bought a mirage band the next day. Another one says "Mr. Preston blew a primer with too much powder and the primer anvil went into the bolt locking lug recess of an AR15 and it wouldn't chamber the next round". This is a common problem with the AR and it needs to be noted. Another one says "Lee Land blew a primer in his AR and the primer anvil went into the trigger group locking it up". Read over your notes from time to time and trends and bad habits will begin to show a pattern. Also, recurring rifle eccentricities will be revealed. Plotting groups will, for instance, tell you if your rifle throws the first few rounds high and then settles down to a round group. An AR15 with a binding gas tube will do this every time.

In summation: if you are a service rifle shooter and just starting out in high power, keep a good data book. If you are an old shooter and don't like to fool with the blasted thing, forget it. However, if you agree with George Shaw, John Rey, and little old me, have fun with a good data book. It will prove to be a valuable friend. And besides, if you go ahead and plot a few groups and scores, you will be able to look back some day when you're too old to shoot and read about the good old days.

I once saw an old shooter leap up in a torrent of curse words and throw his data book all the way across the barracks. Later that evening in the chow hall I asked him about this. He gave me one of those go-to-hell looks and said "I once shot 19 tens and X's at 600 yards in front of a bunch of witnesses. The last shot was an eight out the top. I had forgotten all about the damn thing until I looked in that damn book!"

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Choice of a *COMPETITION TUNE-UP* with 1.75-2.25 lb trigger pull or *TARGET TUNE-UP* with 2.13-2.45 lb pull, or a *HUNTING TUNE-UP* with 2.45-2.75 lb trigger pull.

Installed trigger overtravel screw, forward anti-creep/slack screw plus Auto-bolt release. Groups reworked for best feel.

BARREL SETBACK, shorten chamber by .100, *CPC automatch ream* until a .22 bullet lightly engages rifling, chamber polish, recut extractor slot, fit locking spacer. Cut new 11° target crown. Chamber and crown are cut concentric to bore within .0002ϕ. *Accurize Ruger barrel, contoured or bull or Midway, Butler Creek, Kimber, Shilen, Gun Parts, Clark, etc.*

BOLT REWORK, cut & square bolt face to .041 rim depth, removes play, auto-headspaces on each cartridge, tightening groups and reduces fliers. Bolt is beautifully prism jeweled. Tuneup accuracy increase with your regular ammo, 40-90%.

Add $7.00 for parts if there was a previous attempt at a trigger job, excess refunded. Do not send stock or receiver. Send trigger group, bolt and barrel with $149 m.o., check or cash, one week or less turnaround. Priority U.S. mail return.

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MINI-14,30, trigger job, crisp 3.25 lb pull, send group & $46
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1994 NBRSA Rimfire Nationals: ***Alan Arnette*** won the heavy custom class 100 yard aggregate. ***Clay Spencer*** won the heavy custom class grand aggregate.

1995 NBRSA Rimfire Nationals: ***Tim Mathena*** won the heavy custom class grand aggregate and ***Nicholas Peters*** won the light custom class grand aggregate and 2-gun championship.

1995: ***K.C. Young*** shoots 2 world records in IR 50-50 competition.

1996 NBRSA Rimfire Nationals: ***Alan Arnette*** won the 100 yard unlimited class. ***Clay Spencer*** sets a new 10 shot 100 yard unlimited class record, ***Clay Spencer*** won the unlimited class grand aggregate, ***Clay Spencer*** won the 100 yard custom class, ***Clay Spencer*** won the custom class grand aggregate. ***Bob Barber*** won the 100 yard light custom class, setting a new record.

1996: ***Steve Arnold*** shoots 3 new World Records in IR 50-50 competition.

We are pleased that these shooters chose **Lilja** 22 rimfire match grade barrels in their winning performances. We offer them in a 16" or 17" twist and most contours. Why not rebarrel your target rifle or improve the performance of your hunting or plinking gun with the choice of the champions.

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KEVIN THOMAS ON BULLET SEATING

Dear Dave,

I was pleased with my exposure to ***Precision Shooting***, having been introduced by a bench-rest shooter-patient. I am not (yet) a bench rest shooter, but I do have, as a consequence of my background as a pharmacist and physician, an affinity for perfectionism and accuracy.

As such I have a great deal of interest in methods utilized for determining the distance between the bullet ogive and the rifling. I have used the RCBS Precision Mic, Stoney Point Chamber-All, and methods described by John Wooters. I cannon consistently get these methods to agree, and in many cases, duplicate themselves. During the course of my experimentation I came to the conclusion that the ogive differs among bullets of the same caliber, negating the recommendation for the use of the dummy in the RCBS Precision Mic. I have even discovered different lots of bullets by the same manufacturer produce an ogive that varies enough to alter the seating depth by 0.02" or more. I have not read in any reloading text about this matter and it strikes me that you folks must have the answer. I have accumulated measurements, photos, etc., in anticipation of putting a manuscript together but I've delayed doing so simply because I can't possibly imagine someone out there hasn't already made this observation and I would rather not make a jerk out of myself as I describe another way to reinvent the wheel. Any information or advice?

Sincerely,
Carl J. Forster, D.O.
Pottsville, PA

Dear Dr. Forster,

First, I'd like to offer my apologies for taking so long to get back to you. Unfortunately, Dave Brennan forwarded your inquiry to me the same day I left for the Nationals at Camp Perry. Having only returned last week, I'm just now beginning to catch up on the backlog of projects and correspondence that piled up in my absence. A few things we might wish to address before we really get started here; what type of shooting are you doing now? You mention that you are not yet a benchrest shooter, but didn't say what other types of shooting may be involved. It makes a big difference. High Power shooters, as an example, have a certain set of requirements for their type of shooting which must be met. This results in some entirely different points of view than those held by benchresters, or for that matter, hunters.

Much of this seems to relate to the cartridges and calibers being used in each of the respective disciplines. High Power shooters using cartridges like the .308 Winchester or larger magnums often find that reduced bullet "jump" may increase accuracy in the long-range events. This has resulted in one form of seating known as "soft seating". I practice, the neck is sized to an appropriate dimension to give something of a slip fit to the seated bullet. Upon their initial loading, the bullets are seated out far enough to protrude well into the rifling. When the round is chambered, closing the bolt causes the bullet to be pushed back in the neck. Naturally this results in a solid jam fit, which does seem to be beneficial in some big bore rifles. This does not necessarily carry over to the smaller cartridges use in benchrest competition, or for that matter, several other types of shooting. Having related the fact that I've used the soft seating technique with some success in High Power, I'll add that I've also played with several Thomson/Center Contenders that refused to shoot their best unless the bullet had a running start of .050" to .060" off the rifling. Bottom line here; there is no magic number, no hard rule, no stone tables relating to seating depth. Every gun is a law unto itself, and all that can be offered is a suggestion as to where to start your experimentation. Just remember that seating depth affects pressures, act accordingly, and the rifle will tell you what it prefers.

Okay, so where do we start? I can appreciate your frustration in dealing with the various seating depth tools you have described, but they really do offer the best method for determining what's going on inside the rifle. Each tool and/or method has its own advantages and limitations, which should be understood before making any absolute decisions.

The RCBS Precision Mic is a neat little tool, but clearly has its limitations. While it is an informative device, the single "bullet" included with it does pose some obvious problems. First, there is no possible way that a single "universal" bullet can be used to set the ogive to rifling relationship for differently profiled bullets. To the beginning handloader, this tool serves a valuable purpose and is easier to manipulate than many of the other tools on the market. The more advanced will quickly see that this system has some inherent problems. It's a good little tool for some applications... establishing seating depth just isn't one of them.

It is, however, a big step up over the older methods of "smoking" the bullet with candle soot. You had complained of the results not being repeatable, and I would hazard a guess that this would be the least reliable of all. It is a time honored method of setting the seating depth, which is a polite way of saying that there are still a number of inveterate "senior" reloaders who absolutely refuse to acknowledge the superiority of the newer methods. Many of these folks also define anything "new" as anything introduced much later that the '03 Springfield. This same "smoking" technique may also be performed using a Magic Marker in lieu of soot, but this is at best a minor

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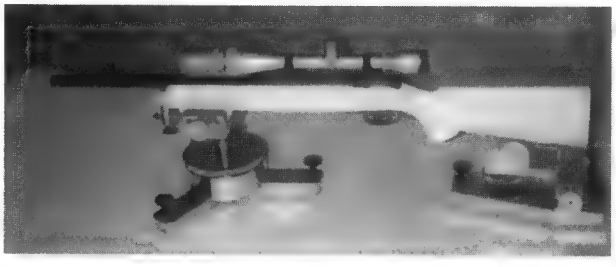

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improvement on an unacceptable process.

The method I've found the easiest and most reliable is that offered by the Stony Point unit. Actually, I've been using a very simple tool that operates in much the same method for many years now. Designed by Al Davidson and marketed by Sinclair, it uses the measurement taken from the base of a bullet which is resting on the rifling, to the base of a fired case in the same chamber. This requires taking two separate measurements, from which the correct seating depth can be calculated. The Stoney Point gauge essentially accomplishes the same thing, but considerably streamlines the process. Both methods are equally good, but do require a rather deft touch. Bear in mind that you are making the OAL determination by Braille, as it were. Doing this procedure a number of times will yield several different measurements which should be close, but are not likely to be exactly the same. Like velocity and thrown charge weights, this is just another of the measurements/readings which entails an extreme spread and a standard deviation. These figures are merely a starting point, so don't worry too much about some minor variation. Translating these figures into a useable number is the real goal here, and is accomplished with a comparator. I'll admit a personal preference to the units made by Davidson, but those from Sinclair, Stoney Point, and others undoubtedly give equally good results. Once this dimension is obtained, it is a simple matter to match up the same "jump" with another type or style of bullet. The gauge and comparator in use together will also allow an effective method for measuring throat erosion, and ongoing situation which must be monitored.

I would suggest that you obtain a copy of *Sinclair International's Precision Reloading and Shooting Handbook,* the new *PS Reloading Handbook* and Glenn Newick's *The Ultimate in Rifle Accuracy*, as three sources that will provide good information concerning the topic of seating depth. I hope this information is of some assistance. If there is anything more that we can do for you, please don't hesitate to give me a call at (800) 223-8799. We'll be glad to help.

Sincerely,
Kevin Thomas
Chief Ballistician
SIERRA BULLETS
(And ***PS*** Columnist)

THE COMPETITION SHOOTER AND EYESIGHT

by

Dr. Ken Erickson

One of the serious and limiting factors in successful iron sight shooting, especially as we get older, is the visual factor. It is particularly unfortunate in many respects since as pointed out in David Tubb's book, it should be a shooting contest, not a seeing contest. The eye doctors I have consulted tell me that around age 40, changes occur that are not reversible. Luckily, most of these changes are successfully treated with ordinary prescription shooting glasses and the shooter can look forward to many more years of unhandicapped competition.

The real problems start 20 to 25 years later as the eye gradually loses its ability to accommodate, and this is often complicated by the increasing incidence in cataracts. For those older shooters like myself who are reluctant to give it up, there are all kinds of aids available to try, most of which are expensive. One or two tries are not adequate to determine whether or not they will help under all conditions; by the time you find out that they have no value, they are no longer returnable. I have a pile of that expensive stuff in my shooting box that I never use any more, but that is too valuable to throw away. Many of us go from one possible solution to another, and if a noticeable improvement fails to occur in a reasonable time period, the gadget is abandoned and another one tried. Pretty soon you have the feeling you are grasping at straws. Crossman said it best when he mentioned that "Some shooters have to be told that they are too old to compete. Others cheerfully admit it and save a lot of trouble!"

Since everyone wears shooting glasses (or should!!), this is the most obvious thing to try to improve our sight picture. Here again, these things are expensive, and to try all of the different lens and color combinations can rapidly run into big bucks. It is worthwhile to try to get them right on the first attempt. Many years ago, one of the service shooters at Camp Perry mentioned to me a method to improve the usefulness of shooting glasses that does not involve an extra expense and gives a definite improvement:

When aiming using conventional shooting glasses, most everyone knows that you cannot use the optical center of the lens since the face is resting on the stock on its side, not on the chin! A little investigation discloses the fact that the upper corner of the lens of the aiming eye is used to get the sight picture. Here is what you do to find you own optical center: Go to the nearest hobby shop and buy a 3 foot length of piano wire, the straightest one you can find. It should be just large enough to pass through the rear sight aperture, and I would suggest that you remove the expensive adjustable iris eyepiece and replace it with an old fixed one.

Get out an old bottle of colored nail polish, and all your shooting gear, rifle, shooting coat, sling, mitt, etcetera. You also need an assistant. Put on your shooting glasses and get into the coat, mitt, etcetera. Pass the piano wire through the front and rear apertures of the sights on the rifle. Holding the rifle in aiming posture for the standing position, put a tiny drop of wet nail polish on the end of the piano wire. While aiming normally, have the assistant slide the wire carefully back until it touches the shooting glass lens. It will leave a small nail polish mark on the lens. Repeat this procedure for the sitting and prone positions. You will then have three little dots on the lens for the different shooting positions.

If you take the glasses to an optical center, you can request that they grind the new lens to place the optical center of the lens in the area of the three little marks and not where they usually put it, in the center where the eye would normally look through it. Insist that the optician double check this, because it is an unusual request. I have never been charged extra for this service. As a result, this is a very worthwhile option to try and will usually give the optimum vision possible using ordinary shooting glasses.

A recent article reviewed the Knobloch shooting glasses and mentioned the advantages that they furnished. However there was no mention of several serious disadvantages, which I found after giving them an extensive tryout. The lens used for the aiming eye is on the end of a long and very vulnerable stem. The first time I tried them, I was getting along beautifully for the first three or four shots and then started to have problems. An examination disclosed that I was getting hit slightly by my rear sight (I am a stock crawler) and

Continued on next page

MOUSEGUN PROBLEMS

by Howard N. Beers

(photos by Lisa Andrzejewski)

As I am very inexperienced in this business of writing to editors, I have found it necessary to consult my friend and shooting companion Doug Randall for literary guidance. I am an avid, as opposed to accomplished, highpower shooter. I live in the Northeast Metro Atlanta area and we are extremely fortunate to have several ranges available for highpower. Within three hours driving time are three 600 yard ranges and one 500 yard range. It is about a 3½ hour drive to Oak Ridge, Tennessee, which as any highpower shooter knows has a 1000 yard range and Big Ed's Pizza. Truly, wealth can be measured in more than one way.

I have just finished reading several articles in the November issue of ***Precision Shooting*** which related to Camp Perry this summer. I also attended the matches as a competitor, however my experience was somewhat different. On Sunday after the NRA team matches, a number of folks returned to our condos near the drawbridge in Port Clinton. My next door neighbor, a shooter and as it turned out a fine gentleman, accidentally parked his small pickup truck on top of a large decorative rock at the edge of the parking lot. His son (an outstanding shooter) and myself were able to lift the front of the truck, allowing him to successfully back off of the rock. However, located between the rock and the hard place, i.e. truck bumper, was my right hand and the most necessary of shooting implements, my trigger finger.

A while later after the good folks at McGruder Hospital had removed the large portions of dangling tissue from my finger, my wife drove us to Bell Mell's to meet a group of shooters from Alabama. The ensuing large quantities of beer made my depressing plight less of a concern. So, I spent the next four days trooping back and forth to various firing points on Vaile Range scoring for shooters whose designated scorers had not appeared. But my wife was able to compete, and my bandaged hand resulted in many questions and much valuable entertainment for those who were shooting. All in all, I was very fortunate as I still have the finger and it works much the same as before, which is to say that it refuses to release the sear when the black is centered in the aperture.

Now, to the point of this letter. Roy Baumgardner discusses an incident with the approved safety flag and his mousegun. This happened to my wife about two years ago at the Georgia Service Rifle Championships. The flag on her rifle was firmly jammed above the bolt and into the charging handle underside. Had it not been for the presence and efforts of an outstanding U.S. Army AMU armorer, her shooting day would have ended. As a result of this incident and subsequent discussions with other shooters, some folks from South Florida had an interesting solution which I believe is optimal while meeting a strict interpretation of the NRA safety flag rule as presently written.

The yellow flag is cut from the long stem of the issue safety flag. It is then attached to the commercially available orange safety block that is inserted through the magazine well. By attaching the flag with screws to the orange block, the flag portion is forced away from the side of the block. This angle allows the flag portion to naturally guide through the ejection port on the upper receiver. This meets the requirement to have an exposed yellow flag, and with the orange block in place it is impossible for the bolt to close. When removing the block, activating the magazine release button while applying downward pressure to the exposed flag will allow it to be pulled free. With the flag attached, the orange block will not fall free from the magazine well. Admittedly, the stem of the flag does not enter the chamber, but the current rules do not require this to occur. While in theory this would allow the presence of a cartridge in the chamber, the bolt cannot close with the block in place, and I have not heard of an instance of a "cookoff" firing under the conditions that would prevail at a match.

My wife used this type of block at the Nationals this year with no voiced objections from any line officer. Hopefully, the enclosed photographs will illustrate this more clearly than I can explain. Having also struggled with the approved flag, maybe this will save others some frayed nerves.

THE COMPETITION SHOOTER ...

Continued

the lens had rotated and tipped in. It doesn't take very much, either, since I was completely unaware of the sight just barely ticking the lens. The other problem is that of very inadequate eye protection. The lens is small and nowhere near covers the eye. The blinder, if used on the non-aiming eye, is made of thin plastic. I intend to try these glasses for smallbore, but for highpower they are one of my expensive discards.

It's here...!

The 1996 Precision Shooting Annual

The 1995 Precision Shooting Annual was not only critically acclaimed (which is always nice, of course), but it also sold thousands of copies (Look, we don't want to sound mercenary or crass about this... but sentence two is a whole lot more important than sentence one around here. The artistic satisfaction that Michaelangelo derived from painting the Sistine Chapel was unquestionably a wonderful thing. But we have to note that he still made certain that the Pope paid him from time to time... artistic satisfaction notwithstanding).

The 1995 Precision Shooting Annual was big... over 500 pages. We don't go backwards here at PS; we try to keep going forward. Thus... the 1996 Precision Shooting Annual goes over 600 pages. None of this "A pleasant evening's reading" for the 1996 PS Annual. If you want to read it more or less consecutively... select a three day weekend... tell the family you don't want to be disturbed (*yes, talking to me would indeed be considered disturbing me*)... and make sure that you have three day supplies of firewood, microwave popcorn, and Chablis on hand (we can't think of anything else very important right at the moment).

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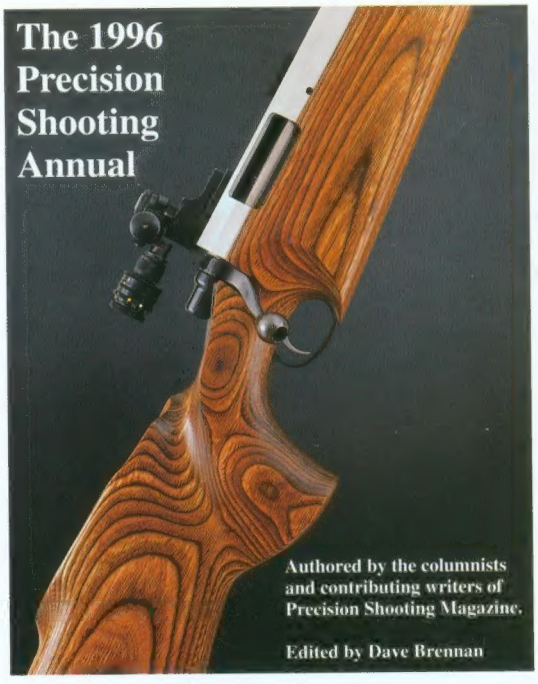
The Honey Bear Affair	Dick Wright
A Shooting at Grandma's	Roy Baumgardner



There are probable "classic" articles in the 1996 PS Annual. If you're a benchrest shooter, the Dave Scott authored exclusive and extensive interview with Tony Boyer will be worth the price of admission by itself. Highpower shooters will welcome what is in wide private circulation, and an underground classic even before we caught up with it, Dave Brantner's *My Highpower Reloading Techniques*, as well as the 90 page Hap Rocketto article on the shooting career of Olympic medal winner Art Jackson, which is just about the story of US Highpower over the last five decades. The story of *The Springfield Armory* by Kevin Thomas is accompanied by great photographs from the author's fact-finding visit to this venerable institution. There's a lot of history and nostalgia in our new '96 PS Annual, and as always, regular PS writers Joe Rychetnik, Roy Baumgardner and Dick Wright prove their abilities as entertaining raconteurs. Plus a dozen more articles, from the likes of M.L. McPherson, Jack Rush, Jim Foral, Bob McCoy and other of your favorite PS writers.

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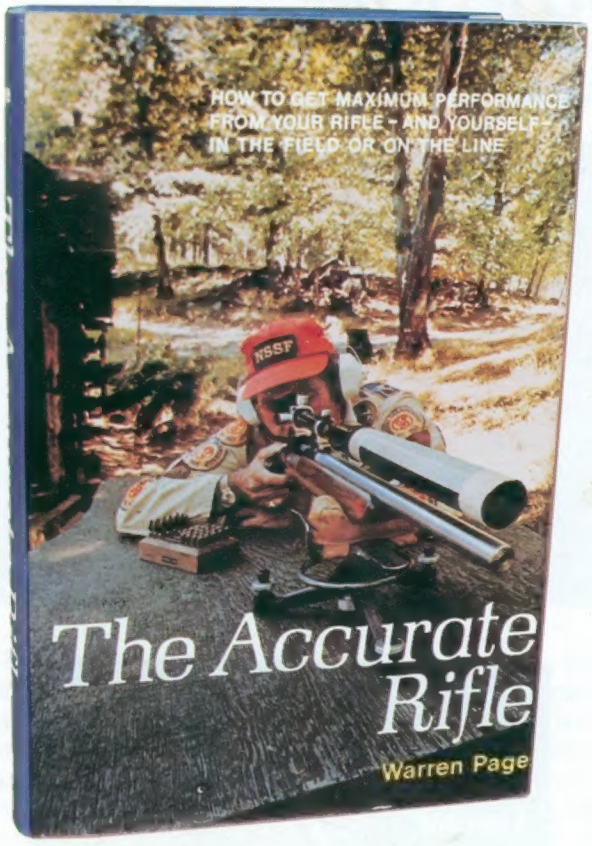
HOW TO GET MAXIMUM PERFORMANCE FROM YOUR RIFLE - AND YOURSELF - IN THE FIELD OR ON THE LINE
NSSF
The Accurate Rifle
Warren Page

The Accurate Rifle

by Warren Page

The 1996 reprint carries every word and photo of the 240 page, 1973 dated original, totally unchanged. In addition, at the very end of the book is an "Update - 1996" chapter, authored by Dave Brennan, Editor of *Precision Shooting* magazine, which will bring the reader up to date on rifle equipment developments that took place between 1973 and 1996.

The topics include the best methods of shooting from bench rest; the most accurate sights and scopes and how to turn them to your advantage; the effect of recoil; the most accurate cartridges; the secrets of proper bedding; how to select barrels and stock; how to clean an accuracy rifle properly; trouble shooting-everything that Page's years at the top of the shooting world have taught him. In addition, *The Accurate Rifle* can be read as an absorbing history of the most dynamic period in the search for accuracy - the last two decades - for Page was there, and he not only knew the pioneers but he was one himself.

From an obituary of the time, for Warren Page's 1977 death:

"Page was an accomplished shotgunner and almost without peer as a rifleman. He held countless world and national records in benchrest shooting - a sport he helped guide through its infancy during the early '50s. At the bench, he was a national champion nine times. He contributed immeasurably to the store of technical knowledge on firearms and ammunition and helped pioneer the introduction of several of today's modern high-velocity cartridges (Primarily the .243 Winchester and the 7mm Remington Magnum)."

Precision Shooting has purchased the entire run of 5,000 copies of the updated edition of *The Accurate Rifle*. The book will be available in both hard cover and soft cover versions, as was the original edition.

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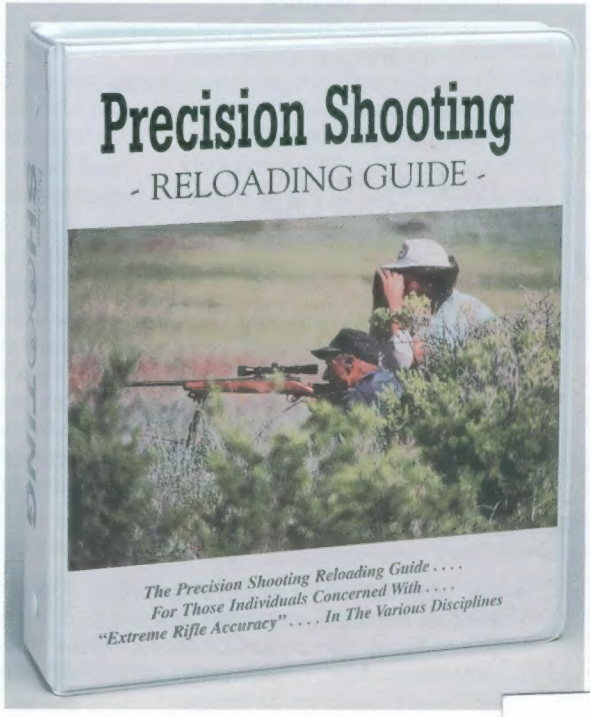
Allow us to quote from the Book Review of The American Rifleman's December, 1995 issue. *"Those familiar with Precision Shooting magazine know it to be an invaluable source of information for anyone interested in 'Extreme Rifle Accuracy'. Following in that tradition is 'The Precision Shooting Reloading Guide'. Rather than offering tabulated loading data for a variety of cartridges - the 'what' of reloading - the Guide covers, in eight authoritative chapters, virtually every aspect of accuracy handloading techniques - the 'how' and 'why'. Topics include reloading for highpower competition (both bolt and semi-auto), benchrest reloading, reloading wildcats and magnums, making and loading cast bullets, load development and an overview chapter on reloading for extreme accuracy. Chapter authors include top competitive shooters, and many leading authorities on accuracy loading. This reference offers the intermediate through advanced handloader the tips, techniques and tools needed to make accurate loads for any rifle discipline."*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